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- HOW TO USE A BENCH GRINDER
- DIY WORKSHOP CHALLENGE



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THE PIETER SCHELTE IS THE FIRST BOAT LARGE ENOUGH TO REMOVE ABANDONED OIL RIGS ALL AT ONCE - WHICH IS GOOD, BECAUSE THERE ARE A LOT OF THEM.



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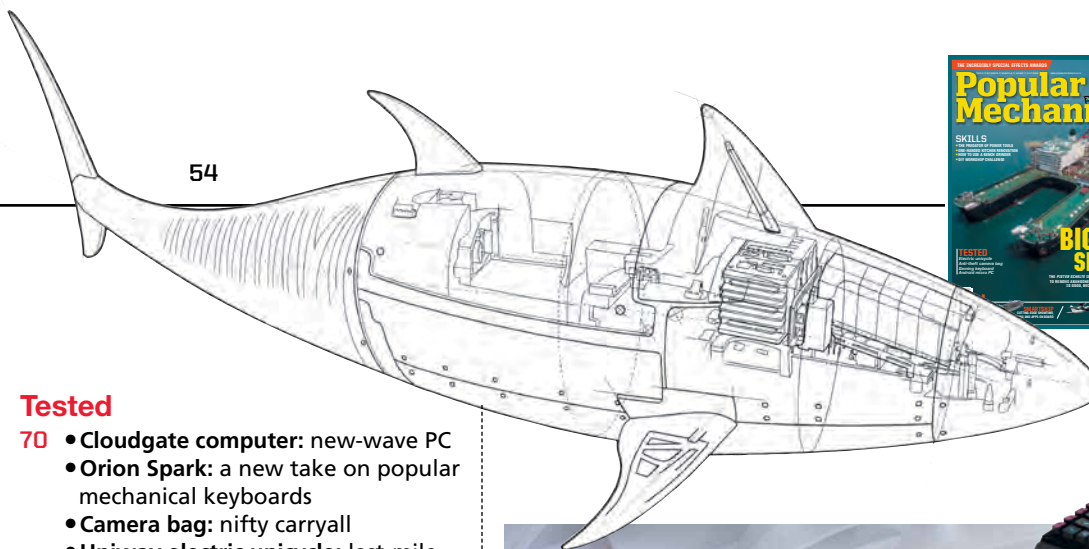
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Cover caption: The *Pieter Schelte* has been in the news not just because it's the biggest vessel afloat (see *How Your World Works*, Page 16) – there's also been controversy about a Nazi connection. This page: Track everything from your luggage to your holiday online while aboard – and by the way, the broadband is super-fast. Cruising just got a whole lot smarter with the arrival of *Quantum of the Seas*.





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Editor Doman gets up close and personal with barber Lazlo, AKA Sweeney. Yes, *that* Sweeney.

WE HAVE A WINNER

It wasn't easy choosing from a couple of thousand entries across PM and our sister titles Leisure Wheels and Getaway, but at last we can announce that Jeremy Farquharson has won our #Where2next? Competition. His story "Foxy and the Zzzrrrr-ZZZZrrrr Adventurers – Soul Odysseys in Namibia" wins a Toyota Hilux 3.0 D-4D 4x4 Raider Double Cab (with selected body kit and cabin accessories) valued at more than R470 000.

Said our judge, noted media man Chris Moerdyk: "Trying to adequately describe a holiday in a few hundred words and handful of pictures is extremely difficult, but Jeremy achieved it quite brilliantly... (stirring) the reader's emotions to the point of wanting to pack a tent, hitch up a trailer and head for the barren beauty that is Namibia."



COMPETITION WINNERS...

Details online at www.popularmechanics.co.za

CLEANING UP

There's a scene you see often in movies of a certain type. It's almost a kind of metamorphosis, possibly a metaphor, definitely a meta-something-or-other: the brooding male central character, his face cocooned in trail dirt, mud and, quite likely, even gore, submits himself to the embrace of clean, hot water, lather and the kiss of a freshly stropped cut-throat razor, to emerge almost miraculously glowing and fresh.

It was evident most recently at a PM preview evening of the WWII tank epic *Fury*, in which the Brad Pitt character Wardaddy transforms from brusque leader to almost civilised human being. He cleaned up good, as they say.

I felt a little bit of that magic myself a few days later in KZN at Nivea's launch of its new male grooming range. As part of the experience, they laid on a gent wielding a gleaming, razor-sharp – obviously – blade around my ears. I didn't emerge looking like Brad Pitt, but no matter. I think I got a bigger thrill than my colleagues who bunged jumped off the top of the Moses Mabhida Stadium in Durban the day before. The luxurious barber shave is a tradition worth preserving, I reckon – and though this was my first, it won't be my last.

Speaking of traditions: the number, range and quality of the entries for our DIY Home Workshop Challenge demonstrated as plainly as daylight what a formidable talent pool we have in PM readers. You can't help but be awed.

It isn't just the breadth of skills; design and execution of some entries were extraordinary, too. Don't be surprised to see them featured in future issues of *POPULAR MECHANICS*.

One aspect I found particularly intriguing is the extent to which computer-aided design and fabrication has taken hold. Come to think of it, that's worth considering as the basis for a competition of its own. Watch this space...

In the end, though, the choice of winner came down to a project that resonates with so many aspects of PM's fine tradition of DIY. Preparing for it needed a bit of thought and a modicum of equipment. It involved the entire family. It required some hands-on time, but nothing too complicated. It produced a useful and, dare we say it, aesthetically pleasing (in a retro sort of way!) outcome. And best of all, it resulted in a feel-good conclusion that underscores the aptness of our choice for Workshop Challenge No 2. Check it out in our Skills section.

anthony@ramsaymedia.co.za

SORRY – AND A COMMITMENT

I know that many of you have not been getting your regular monthly fix of *POPULAR MECHANICS* through the post. To make things worse, our Call Centre has experienced what politicians like to refer to as "challenges". Understandably, you are not happy – and my Inbox has become a place I approach with trepidation. But we'll take it on the chin. You deserve better than this.

I want you to know that the *POPULAR MECHANICS* team, led by our very capable colleagues in Subscriptions, is sparing no effort to make it up to you. Normal service *will* resume. That's a promise.

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LET'S NOT BE BLIND

I deeply respect Steve Wozniak. However, I can't help disagreeing with his views on innovation (January issue).

To say that the Pyramids and the Lunar Landing were not innovative is very close to being labelled technological blasphemy. As he said, innovation must move people forward. Did people not move forward through the pyramids? Were all the water management and building material movement methods forgotten?

Unlike what Steve says, we do need perspective. We can't be comparing keyboards with

typewriters. Typewriters were purely for professionals, such as authors, clerks (even magazine editors!), but the modern keyboard is aimed at the less elite level. It is as commonplace as an action figure was in the 80s; we should be comparing those two and typewriters to computers with 64 GB RAM.

I guess what I'm trying to say is that we shouldn't look at the word "innovative"

with blinkers because *Australopithecus Africanus* discovering that peaches are sweet is just as important as Robert Boyle figuring out the relationship between the volume and pressure of a fixed amount of gas.

TAKUDZWA NGARA (AGED 16)
HARRISMITH



Winning letter

Write to us, engage in debate, and you could win a cool prize. This month's best letter wins a Timex Intelligent Quartz Tide Temp Compass multifunction wristwatch valued at R3 999. While not a smart watch, this intelligent timepiece incorporates a tide tracker, digital thermometer with reliable analogue display and an accurate digital compass with adjustable declination into a rugged and stylish stainless steel and aluminium case.

The proprietary Indiglo Night Light lighting system has a special night-mode to keep your watch face visible when you need it and water resistance down to 100m lets you take it along for any adventure. With the mineral glass-covered watch face showing the time and date in a conventional three-handed style, a dedicated fourth hand handles all of the intelligent features. For more information or to find your nearest stockist, contact timex@tregerbrands.co.za or visit www.timex.com

Send your letter to: Popular Mechanics, PO Box 180, Howard Place 7450, or e-mail popularmechanics@ramsaymedia.co.za Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

What's in a name?

Somehow, for the past four decades, the "Mechanics" after the "Popular" in this mag was imprinted in my mind as exactly that. Confined to mental images of gears and internal combustion *gedoentes*, your publication was given a "pass".

I am one of those who love to take things apart, never to properly reassemble them. We are a generation of users that is keen

to make tech our servants, but because we do not comprehend basic technologies and developments, often the ever-increasing new technology and its associated jargon become our unpopular masters as we lose the ability to create good BS filters through a lack of comprehension and willingness to part with resources of time and money necessary to get on top of everything.

My inquisitiveness had remained frustratingly unmanageable and unrequited until I opened your mag after all of these years. It gradually answers many the questions that I have had, without paying for courses and doing Webwork with enough links to build a chain that plain just sinks your enthusiasm. I subscribed digitally, uploaded the back issues free and use Adobe reader to deliver the goods. As the mag seems to cover much technology and value-to-life articles on all sorts of things, is it not time for a name change, say Popular Life Technology?

WILLIAM MALONEY
BY EMAIL



Lacking the human touch

I am 79 years old and have just read my first POPULAR MECHANICS. I have paid for many subscriptions over the years, first for my son and then for a grandson, but never actually read the whole magazine before I got your January 2015 as a freebie with another magazine.

I can't believe what I have been missing all these years.

As an "elderly" person I feel I must comment on your cover story, specifically Ms Breazeal's answer to companionship for the elderly, whom she assumes are lonely. I think she has rather lost the human plot, or perhaps I should say touch.

Yes I have an iPad, given to me lovingly and without guilt by a daughter. Without guilt because she doesn't see it as a babysitter, but as an enrichment to my life. It, to quote your article by Steve Wozniak, is an "amplifier of abilities" and a useful provider of knowledge.

But Jibo? I don't think so.

I don't want any gadget taking photo-



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graphs of me making coffee in the morning with my hair on end. Nor do I need a disembodied voice to say a spooky "hello" or to tell me my hands are covered with flour when my phone rings.

As people we need each other, we are born into families hardwired to need nurture and there is no substitute for the human touch. What kind of indifferent cold human beings would we produce if we let machines read our children bedtime stories? Perhaps next someone will write an app for Jibo that tells children to "get into bed now and pull up the covers and consider yourself kissed good-night". Remember the line from the Barbra Streisand song, "People who need people are the happiest people in the world"?

Cynthia, if you should ever read this letter, please visit your grandmother, tell her you love her. Better still, take your children to see her and, meanwhile, put your brilliant brain to things that really matter, such as renewable energy and global warming.

As for me I will take my people with skin on them any day.

MERLE TARR
BY EMAIL

More DIY, please!

I love POPULAR MECHANICS, but lately I have found that it is less DIY and more science and technology. I would appreciate it if we could go back to the Mechanics in POPULAR MECHANICS.

Also, could you please refrain from having close to naked ads such as the shaver ad in the January 2015 issue.

JACOB (aged 13)
BY EMAIL

Load-shedding how-to

With Eskom's announcement that we all have to live with load-shedding, I've spent the morning trying to get to grips with home battery back-up systems. It would be great for PM to give us some articles comparing what's on the South African market (including the larger jump-start systems with USB, DC and AC outputs); explaining how to build our own system including how to choose between absorbing glass mat (AGM) versus sealed lead acid (SLA) batteries, size and number of batteries to get, size of the charger needed, whether you need pure sine versus modified sine inverters and the size to get, plus gauging the charge on the system and so forth.

STEVE CAULLEY
KIMBERLEY



Balancing act

I was interested by the article in Ask Roy (January 2015) on the topic of ceiling fans. As an engineer, I know that balancing a fan absolutely perfect takes quite some skill and lots of patience.

Fans are gyros and just by putting weights on the blades can prove to be far more complex than one should think. Weights fitted to blades can have wrong results, making the balancing more difficult. I'm not saying not to put weights on, but do the basics first.

What I do?

First, the basics. So, make sure the fan tracks well (all power off; the fan must be electrically "dead").

Remove all weights from the blades. The blades need to be straight. If a blade is obviously skew or bowed (hanging) it MUST be replaced. It's impossible to balance the fan with non-straight blades.

The blades must be securely fastened to the motor (do note; when blades are fastened, they should form a perfect cross for the four-bladed models and the motor must be secured to the ceiling bracket. We don't want fans falling down...

Just in connection with motors fitted to brackets, some motors are secured with only a pin, allowing the motor to wobble easily. Method will also solve this wobble.

Now, climb on a safe ladder to a height where the blades just clear the top of your head when you turn the fan by hand. Mark one blade with masking tape (just a dot, to identify it). By aiming the marked blade's outer edge with the cornice of the ceiling, try to keep your head as still as possible and slowly turn the fan while still looking at the cornice of the ceiling. Notice that not all the blades are actually passing through your aim at the same height.

If this is the case, the fan "tracking" is out. This means that all the blades do not run in the same rotational plane. The gyroscopic effect caused by the blades trying to run in the same plane results in the fan wobbling due to unequal forces on the motor.

The remedy? Try to slightly bend the

blades at the bracket where they are fastened to the motor. Do not overdo this; it is actually possible to bend them slightly. One should not require a lot of bending, and overbending can loosen the fastening screws on the brackets or even strip them.

When the fan is turned by hand, all the blades should track at the same height through your level of aiming to the cornice. Try to keep your head dead still. I usually mark the blade hanging the lowest and then ever so slightly bend the others down to track on the same path/level.

Once you are done (practice makes perfect) remove the masking tape, climb down the ladder and start the fan. It should wobble less or even run perfectly.

A fan that tracks well won't need weights at all.

THEO A MOELICH
BY EMAIL



Saved by the bar

With reference to the letter from Andre Pienaar of Brackenfell (February 2015) questioning the usefulness of roll bars for bakkies, today I can proudly state that I'm living proof that they do their job.

I was involved in an accident in March 2005, when my Nissan 3.0 V6 LDV plunged down a two-metre embankment. It rolled over three times before it came to rest – on its roof. My point: the bakkie was fitted with a roll bar designed and made by Nissan. The only part of the roof that did not cave in was where the roll bar was located. I was wearing my safety belt, which kept me pressed into my seatback, close to the roll bar area, which was not dented at all. It saved my life.

My advice: get a factory-approved roll bar supplied by the LDV manufacturer.

MIKE HORN
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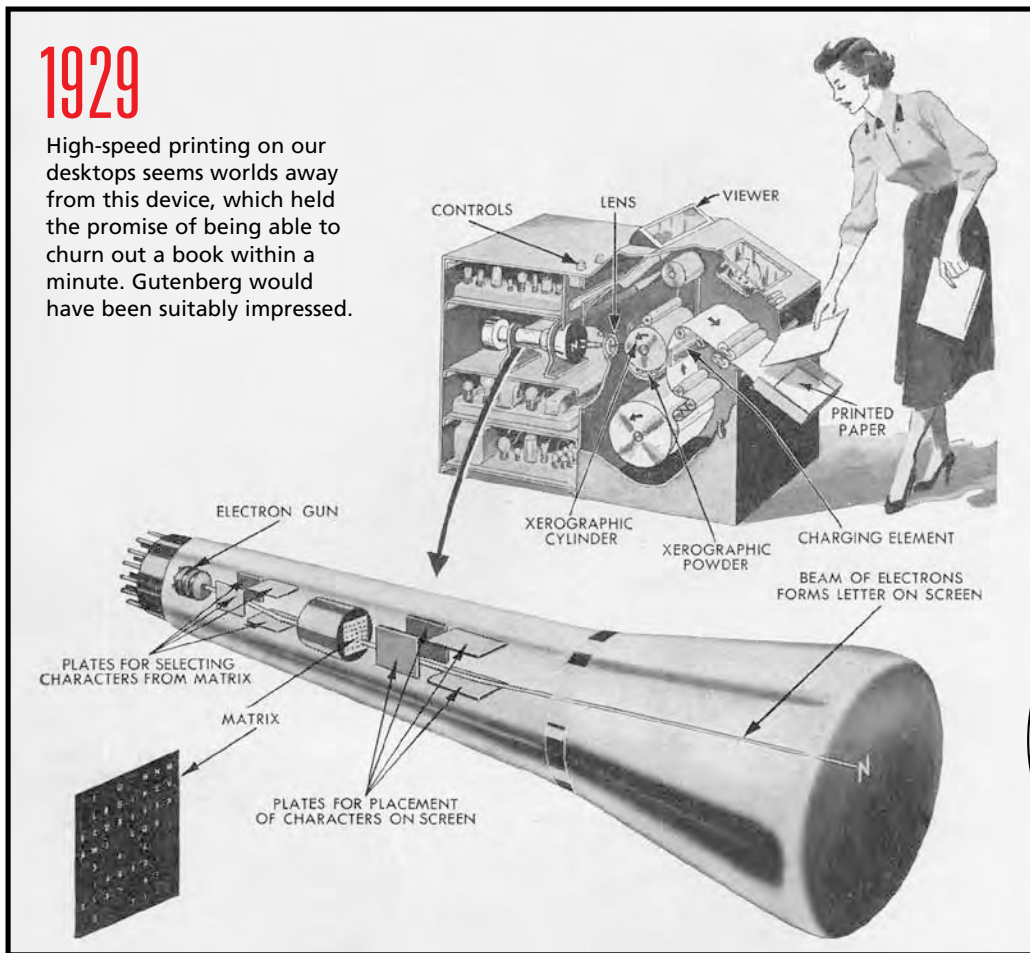
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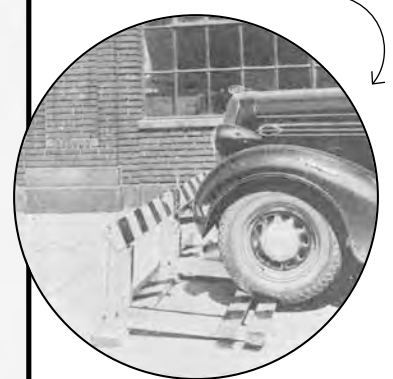
1929

High-speed printing on our desktops seems worlds away from this device, which held the promise of being able to churn out a book within a minute. Gutenberg would have been suitably impressed.



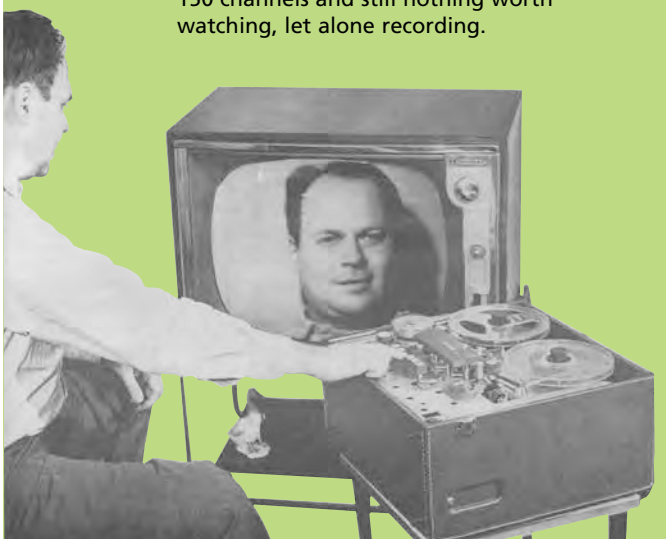
1929

A recent How Your World Works article featured a local security expert's design of a new type of car-stopping barrier that he believes would help solve crime at shopping malls. His design is simpler (it uses a winch) and significantly cheaper than currently available alternatives. Simpler still is this much earlier design, which no doubt proved effective at stopping the likes of Al Capone during Prohibition.



1964

It's hard to believe in the days of PVRs (anybody remember video recorders?) that this massive contraption was viewed as start of the art. It filled up an entire basement. One thing the passage of time has not managed to solve, though: 150 channels and still nothing worth watching, let alone recording.



1936

Sitting bleary-eyed through the early-morning broadcast of the New England Patriots winning their fourth Super Bowl brought home to us how we take for granted connecting to big sports events across the globe. In pre-satellite TV days, never mind pre-Twitter days, the media often had to use their imagination to get the message across to viewers. Here's one effort that seemed to combine foosball with gridiron, using radio broadcasts as a guide to line up mini-players, providing an "action photograph" of sorts. **PM**





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HOW YOUR WORLD WORKS

ESCAPE SUITS ► THE OTHER VIRUS ► INFRARED CAMERAS ► PANCAKES ► CONDENSED BEER ► GREAT UNKNOWNs

The *Pieter Schelte* in sea trials off South Korea. It's now in Rotterdam for final outfitting.

124 m

382 m

Helicopters will help ferry a maximum of 571 crew members aboard.

THE BIGGEST SHIP IN THE WORLD

The ship's draft, or hull depth, ranges from 10 to 25 metres. Water is pumped in and out of the hulls to raise and lower the decks.

The *Pieter Schelte* is the first boat large enough to remove abandoned oil rigs all at once. Which is good, because there are a lot of them.

BY TIM HEFFERNAN

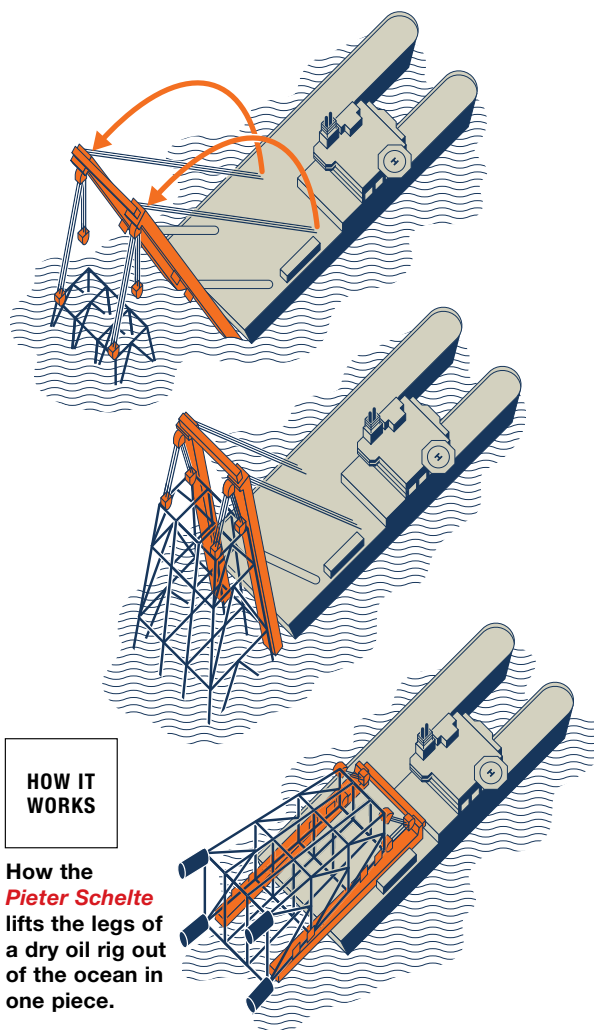
OFFSHORE OIL PLATFORMS FACE AN EXISTENTIAL crisis similar to the rest of the world's: they're in trouble when the oil runs out. But whereas people can turn to other forms of power, rigs are doomed. If they're in the Gulf of Mexico, they'll often be sunk in place for marine life to colonise. (Quite successfully too; a recent study found that rigs are among the most productive fish hatcheries on the planet.) But by law, the dry rigs in the North Sea oilfield, Europe's largest, must be completely removed. Until now this has meant a long process of piecemeal dismantling, but this year, when the Dutch company Allseas' newest ship, *Pieter Schelte*, goes into service, the job will get much simpler.

The *Pieter Schelte*'s enormous size allows it to lift and remove entire North Sea oil rigs in a single operation. A process that currently takes months, or even years, will be accomplished in days.

To do a heavy lift on the water, you need to keep two things stable: the object being lifted and the device doing the lifting. Neither is overwhelmingly difficult in a sheltered harbour, or when the object isn't all that heavy. But the North Sea is no harbour and an oil rig is heavy by any measure. The topside alone – the above-water portion where the living quarters and mechanicals reside – can weigh more than 48 000 tons, and the jacket, or the legs that support the structure below the surface and attach to the seabed, can be many metres long and weigh more than 25 000 tons.

An automated dynamic-positioning system keeps *Pieter Schelte*'s frame stationary in the notorious North Sea currents. When it's time to lift a topside, the ship manoeuvres so that the oil rig stands between its hulls, almost touching them. Eight immense arms slide out from the decks and clamp the topside (which was previously cut from the legs) in an unbreakable hydraulic grasp. To eliminate the tension created by the ship's yawing and pitching on the water, the clamps adjust constantly with the waves. Ballast water is pumped out of the hulls, lifting the ship and topside, and both bob free like the world's largest cork.

Removing a jacket is a different challenge, since the



HOW IT WORKS

How the *Pieter Schelte* lifts the legs of a dry oil rig out of the ocean in one piece.

1 The 160 m lift arms rotate vertically off the stern, and cables are attached to the jacket.

2 The jacket is winched upward and anchored to the lift arms.

3 The lift arms rotate back to horizontal, levering the entire jacket on to the deck.

torque involved in rotating such a huge structure is enormous. A pair of 160 m long lifting beams tilt down from the ship's stern, and the jacket – previously severed at the seabed – is winched tightly against them. When the beams tilt up again, the entire jacket ends up lying flat on the *Pieter Schelte*'s deck: the Eiffel Tower on a sunbathing cruise. All in a matter of hours.

The *Pieter Schelte* took eight years to build, and that timing is no accident. Over the next 25 years, numerous tapped-out North Sea oilfields will need their abandoned rigs removed, with more rigs waiting to be installed in new sectors to replace them. The *Pieter Schelte* can do that, too.

HOW TO RECYCLE AN AIRCRAFT CARRIER

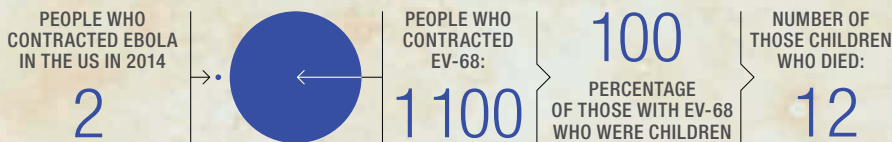
After 21 deployments, the USS *Constellation* was retired in 2003. For 12 years the 61 981-ton ship just sat there, patiently waiting for an influx of private funds to turn it into a museum. That didn't happen, so this winter *Constellation* was towed from Puget Sound, around the southern tip of Chile, and up to the International Shipbreaking company in Brownsville, Texas. After flushing the tanks and lines of fuel, ISB will remove the superstructure (the top level, including the flight deck), then harvest the high-value piping. The stern and bow will be torch-cut into steel panels that weigh as much as 20 tons, then trimmed into manageable pieces with hydraulic shears. The metals will then be sent to mills to be melted down and repurposed for commercial use. Which means your next can opener could be battle-tested. — LOULOU FORD



HOW YOUR
WORLD WORKS

THE OTHER VIRUS

BY KIERA PEIKOFF



LAST YEAR, WHEN THE EBOLA frenzy had everyone focused on where a nurse in London rode her bike, or what train a New York doctor took in a feverish trip to a bowling alley, many scientists were concerned with something else entirely: enterovirus D68 (referred to as EV-68). It's a pernicious bug that causes respiratory illness and in three months it sickened more than 1 100 children in 47 US states, killing 12. In some cases, EV-68 is linked

to an unexplained kind of paralysis that appears indistinguishable from polio. The most severe cases of paralysis have left children in wheelchairs, requiring assistance to speak and breathe.

At this point there is no treatment. If you get EV-68, there's nothing you can do but wait and hope. The disease is not new – the first case was isolated in California in 1962 – but it was hardly seen in the US until about five years ago. Last year saw the largest outbreak

ever recorded, leaving scientists to speculate that the virus has mutated to become more contagious – and much more dangerous.

According to Mark Pallansch, director of the division of viral diseases at the Centres for Disease Control and Prevention, EV-68, like any enterovirus, "is highly variable and unpredictable. We don't know what will happen next year".

Such variability makes vaccine development tricky. Eckard Wimmer, a virologist and distinguished professor of molecular genetics and microbiology at Stony Brook University, says that although "it's not known whether or not the genome of the virus has undergone changes that would make it more dangerous than the same virus 10 years ago", everyone from the US Centre for Disease Control to pharmaceutical companies is working hard to find out. The first step is to sequence the new genome. Then, Wimmer says, using a method of computer designing, researchers must change the coding capacity of the virus, which stops it from being able to produce enough viral protein to cause disease. After that, it's on to animal testing before they can apply for human trials. "We have not yet solved the problem," Wimmer says, "but we did recently get a new result that is promising. The first stage in our work would take five months to complete. But the next stage would take much longer."

Not great news. But one more good reason to make sure you're washing your hands, a simple measure that EV-68 researchers agree is the single best way to avoid it. And which you are probably doing wrong. Instructions below.

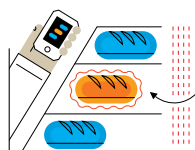
THE BETTER WAY TO WASH YOUR HANDS



Soap doesn't kill viruses. When you wash your hands, soap and friction loosen viruses' grip on your skin, and water washes them off. This is why you should recite the ABCs while you wash up (just do it in your head) — the extra time encourages you to hit all surfaces of your hands. If soap is just too much work, run your hands under water, which will at least kill bacteria. Bacteria are not osmotically balanced, so if you put them in water, the pressure outside the cell becomes greater than inside and the cell bursts. As a side benefit, you might fool a few more people into thinking you're not an animal.

THE CASE FOR INFRARED

New heat-sensing attachments for your phone are so much fun, you won't care if they're useful. (They are.) – BY DAN DUBNO



Unnecessary but enjoyable ways to use your new thermal sensor: dominating hide-and-seek • picking the freshest bread at the bakery • determining where the fewest people touch the bathroom-door handle • instantly knowing who's nervous

IT WAS IN AN M1A2 ABRAMS main battle tank that I first discovered how to see properly. The US Army Armour School had invited me to spend a day in its simulator in Orlando, Florida, and, after looking through the commander's thermal camera unit, it occurred to me that I should have one of my eyes replaced by a cybernetic thermal device. The imager allowed us, day or night, to penetrate camouflage and clearly observe adversaries glowing several hundred metres.

For the past two decades, civilian infrared options have been bulky and expensive, used mostly by fire departments locating people in burning buildings and contractors identifying poor insulation and overheated wires. But thanks to significant innovations in infrared chips, called microbolometers, two new thermal devices are available – and actually affordable – to folks like you and me. And they fit right on your phone.

The **Flir One** (R4 000) offers the most elegant solution, sliding onto an iPhone (only the 5 and 5s, for now) like a case. Its two cameras

merge an 80 x 60-pixel thermal image with a black-and-white VGA (640 x 480) picture, so it's easy to know exactly what the heat images are showing. When I took a shot of myself reenacting Munch's *The Scream*, the camera highlighted a hot burst of white coming out of my mouth, my red cheeks, and the orange/yellow of my cooler arms.

Seek Thermal (thermal.com) is more affordable and smaller, and offers higher infrared resolution (206 x 156). Sadly, though, Seek doesn't merge heat images with actual photos. This can make it hard to recognise what you're looking at, like when I struggled to distinguish among hot electronic components in my friend's crowded workshop. But Seek makes up for this with a wider field of view and easier usability. The unit plugs in to any micro-USB slot or iPhone Lightning connector. Seek claims its sensor is sensitive to thermal signatures in the 7- to 13-micron range, and that it can differentiate temperatures from minus 40° C to 330° C.

But the real question: What to do with these things? You can be practical and check pipes for leaks, but you might as well have a little fun. I've been using mine to spot raccoons or to test the surface temperature of my grill. According to Seek and Flir, this is only the beginning. The technology will continue to get smaller, cheaper and more powerful – and I'll be able to see a glowing world with vision like a tank commander's without giving up one of my eyeballs.

Contributor
Wylie
Dufresne
cooking
pancakes
for the photo
on page 20.



THE 15-SECOND REVIEW: SLEEP TRACKERS

WHAT THEY ARE: Devices that improve sleep habits by recording pulse, respiration and sleep quality. The Withings Aura uses a sensor the size of a hand towel that slides under the mattress, and has a nightstand alarm clock that wakes you with a soft light. Beddit Sleep Monitor is a thin strip that sticks to the mattress, under your sheets, and pairs with a phone app.

WHY YOU MIGHT WANT ONE: The wake-up is timed to the ideal part of your sleep cycle. For once I wasn't groggy.

WHICH ONE YOU SHOULD GET: Withings had a gentler wake-up, and white noise that helped me fall asleep. Beddit was easier to set up, but it didn't seem as accurate. – CAMERON JOHNSON

HOW YOUR
WORLD WORKS

IN PRAISE OF THE PLANCHA

It's a fancy name for a griddle. It's also the most useful heat source you can install in your kitchen. – BY WYLIE DUFRESNE

PLANCHA IS SPANISH FOR “METAL PLATE”, and lest it seem like some kind of unnecessary, highfalutin equipment, let me clarify: It's a griddle – a big metal slab with a heat source under it, either electric or gas. The first time I ever saw a plancha in a professional kitchen, at Jean-Georges in 1996, I couldn't figure out why a serious chef would want one. But I ended up loving the thing, and I've had several at every restaurant I've run since.

The plancha is an incredibly simple piece of kitchen equipment: the metal plate is usually stainless or A36 steel, which is used in construction because it's strong, but easy to machine and weld. The genius is that once the plancha's steel reaches the temperature you've set, it provides a completely even, consistent heat source across the entire surface. It doesn't fall off towards the edges. There are no hot spots. Your pan never heats unevenly. Because the plancha is the pan. More important, it has a lightning-fast recovery time. This means that after you put cold food on the hot metal, the plancha rises right back to the correct temperature quickly, like a fryer does. Rapid recovery time provides more control and reduces the likelihood that the food will stick.

I have a built-in griddle from Viking as part of my stove at home, and I can't get enough of it. A few months ago I cooked 8 kg of bacon for a wedding brunch, and I didn't have to stop once to deal with the grease. All the rendered fat slid directly into the drip pan in front, and I cleaned it up after the fact. Built-in planchas are incredibly useful when you need to cook a lot of food for a lot of people at one time, or when you need to play the part of a short-order



Dufresne demonstrates one of the virtues of the plancha: All the pancakes are ready at once.

cook for picky kids, as I often do. You can cook a half-dozen dishes on it at once, then clean only one surface.

If I have one big regret about my home kitchen renovation, it's that I didn't allocate more of my range to the plancha; mine is the size of two burners, and I could easily use one that's twice as big. I've been wondering for years why more home cooks don't have one of these surfaces, and, best I can figure, people think they need the burners. They don't want to give them up to make room for a big, weird slab of metal. Here's my opinion: Give up your burners.

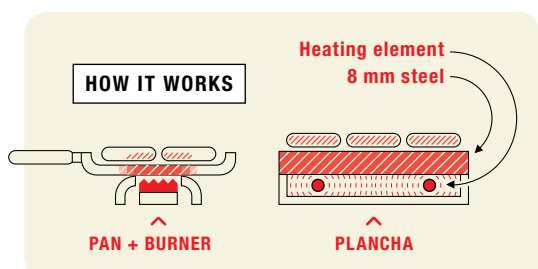


HONOURABLE MENTION:

The grill pan

If you're not reconfiguring your range anytime soon, get a stovetop grill pan, such as the cast-iron Classic Mixed Grill from Le Creuset (R2 000).

PHOTOGRAPH BY GREGG DELMAN



A GUIDE TO PLANCHA THERMODYNAMICS

Cooking depends on the transfer of heat, and every cooking method transfers heat into food a little differently. A plancha works through conduction, the motion of energy through and between solid objects. As the plate heats up, energy is transferred between adjacent steel molecules. Some of that energy is released into the air through a process called convection, but in planchas with thick steel – 8 mm in the case of the Viking 5 Series, which we modelled at left – most of the heat sticks around to cook your food. This makes for a surface free of hot spots. And a chef free of exasperation.

HOW YOUR
WORLD **WORKS**

MEANWHILE,
IN BEVERAGE NEWS...

100% BEER (FROM CONCENTRATE)

A new product lets you make a fresh beer the way you make a cup of instant coffee. But do you really want to? – BY MATT GOULET

IF YOU'VE EVER TASTED A MILLER LITE, you know it takes a lot of water to make beer. That water is heavy – one litre per kilogram. Which means that there's a huge monetary and environmental expense in transporting and distributing kegs and cases around the world. But in 2008, Pat Tatera of Pat's Backcountry Beverages in Golden, Colorado, came up with a solution: add the water after you ship the beer.

Previous efforts to concentrate beer have involved removing water from full-fledged brews, taking away much of the beer's flavour in the process. Tatera, a chemical engineer and home brewer, came at it a different way. He devised a process he calls nested fermentation, whereby a beer is brewed in the largest amount of malt and with the least amount of water that the yeast can survive in and still effectively ferment. That beer is vacuum-distilled, which means the air pressure is removed and the alcohol from the brew is evaporated, extracted and set aside for later. Left behind is a thick, non-alcoholic beer that gets brewed with a new batch of malt and yeast to make another, highly alcoholic, beer. The process is repeated several times before the syrup and the alcohol removed in each batch are combined to create a fluid that's 58 per cent alcohol by volume per 50 ml packet. And looks like motor oil. There are three ways to turn the syrup into a real beer. You can add a packet of the company's 1919 Pale Rail ale or Black Hops IPA-style concentrate to a pint glass of cold soda water, or run it through a home soda maker. Or you can take it on the go and mix still water and the concentrate in Tatera's patented carbonator – basically a SodaStream in a

Your next beer.
Just tear open,
pour into a pint
of seltzer, and
give it a stir.



THE TASTE TEST

By Dave Arnold, bartender and author of *Liquid Intelligence*
“Conceptually, kudos to these guys for pulling off such a crazy idea. My bartenders could make an interesting cocktail using the syrup as biters. You get a nice head on the beers when you stir them up in the glass. The Pale Rail tastes like a beer. It's definitely not the worst I've ever had. Sort of like Yuengling. That is the better of the two. They hopped the hell out of the Black Hops. It was hard for me to taste it. It's over-caramelised, with a candied flavour at the end.”

Nalgene bottle. When reconstituted, you've got a craft beer that can stand up to traditional brews. Really. (See above.)

The company is introducing yet another way to dilute its syrup with the release of a reconstituting tap later this year, meaning that beer from concentrate could be on draft at the bar right next to traditionally made brews. It'll be the most flavourful watered-down beer you'll ever order.

COCKTAIL SCIENCE! Shaken versus stirred

By Jackson
Cannon, owner and
lead bartender at
The Hawthorne in
Boston

SO YOU WANT TO
MAKE A COCKTAIL.
START WITH



MIXER?



HOW YOUR
WORLD WORKSA SCIENTIFIC COMPANION TO...
BLACK SEA

Jude Law stars in the new movie *Black Sea* as a moody and recently laid-off submarine captain hired to find Nazi gold entombed in a U-boat at the bottom of... the Black Sea. The characters may feel a little familiar, but the movie is good. Entertaining. And it brings up some fascinating science, which we consulted with leading experts* to explain. Just be ready for a few minor spoilers.

— CAMERON JOHNSON

1 Plot point: Miraculously, the German sub did not rust away.

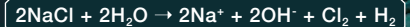
WHY NOT? The Black Sea is a combination of fresh water and salt water. Because of its higher density, the salt water sinks to the bottom and remains mostly separate from the fresh water above. This means that air acquired through the waves on the surface can never make its way to the salt water below. Without oxygen, the deeper water serves as a natural preservative for metals.

2 Plot point: Escape suits, which inflate to bring crew members quickly to the surface, don't cause the bends.

IS THAT REALISTIC? Submarine Escape Immersion Equipment (SEIE) fills with CO₂ to ascend at a rate of 2 to 3 metres per second. Because the submarine was pressurised to a level equal to the surface's, the bends are not a threat. But exploding lungs could be. According to Boyle's law, as pressure decreases, volume must increase, so as the crew surfaced (from 350 metres, a 35-fold pressure increase), they would have had to exhale — reducing the amount of air in their lungs as it gained volume. If you happened to be screaming, you'd be all set.

3 Plot point: After decades underwater, the German sub was filled with deadly chlorine gas.

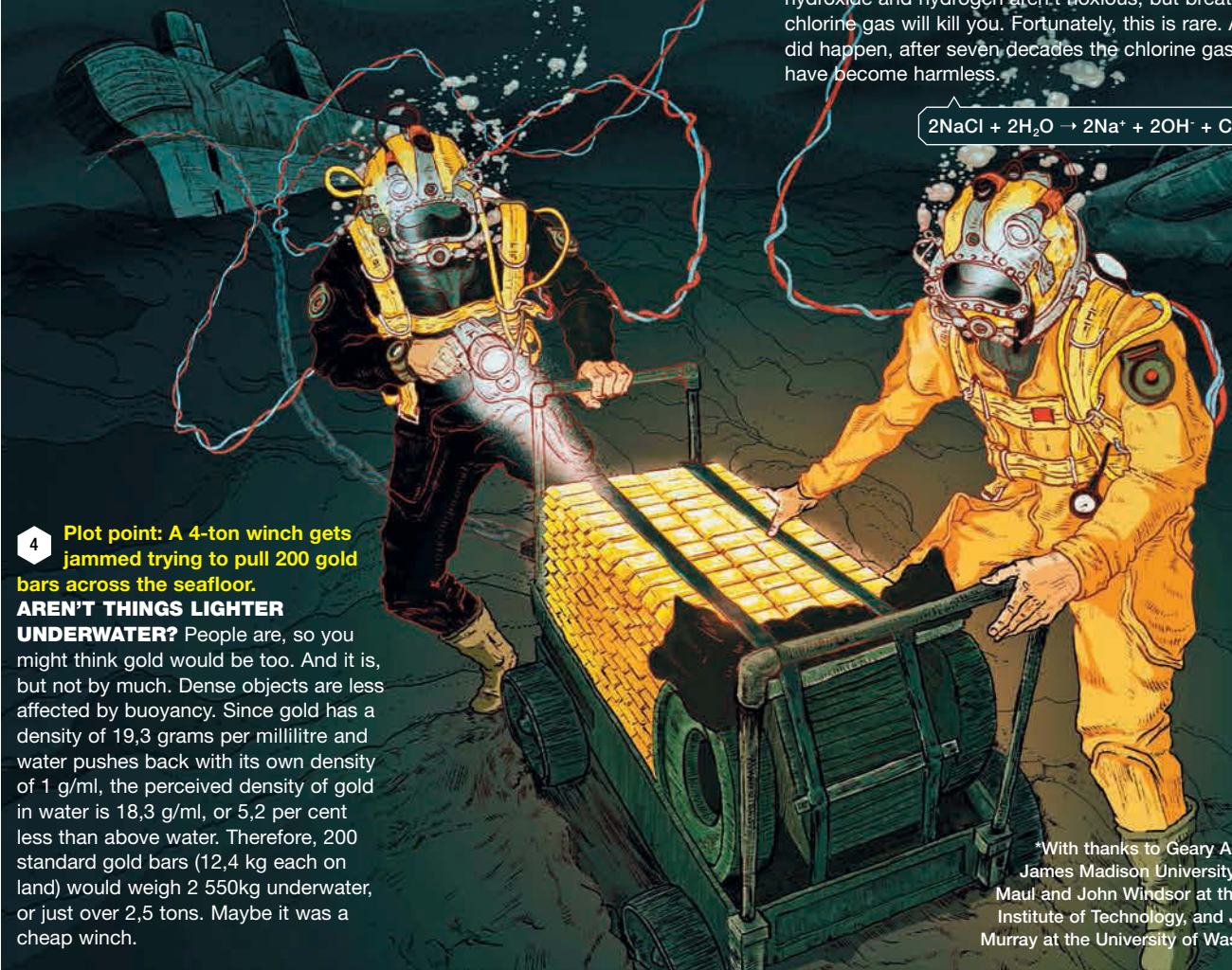
COULD THIS HAPPEN? It's possible. If any water reached the battery compartment, the electrical current would cause electrolysis, a chemical reaction that separates the water's molecules (see below). Sodium hydroxide and hydrogen aren't noxious, but breathing chlorine gas will kill you. Fortunately, this is rare. And if it did happen, after seven decades the chlorine gas would have become harmless.



4 Plot point: A 4-ton winch gets jammed trying to pull 200 gold bars across the seafloor.

AREN'T THINGS LIGHTER

UNDERWATER? People are, so you might think gold would be too. And it is, but not by much. Dense objects are less affected by buoyancy. Since gold has a density of 19,3 grams per millilitre and water pushes back with its own density of 1 g/ml, the perceived density of gold in water is 18,3 g/ml, or 5,2 per cent less than above water. Therefore, 200 standard gold bars (12,4 kg each on land) would weigh 2 550kg underwater, or just over 2,5 tons. Maybe it was a cheap winch.



*With thanks to Geary Albright at James Madison University, George Maul and John Windsor at the Florida Institute of Technology, and James W Murray at the University of Washington.

HOW YOUR
WORLD WORKS

Do you have unusual questions about the world and how it works and why stuff happens? This is the place to ask them. Don't be afraid. Nobody will laugh at you here. Email popularmechanics@ramsaysmedia.co.za Questions will be selected based on quality or at our whim.



Q

WHY ARE BRICKS THE SIZE THEY ARE?

Why not make them even, like, twice as big, which would conceivably cut construction time in half?

A **WHY STOP THERE? WHY NOT MAKE EACH BRICK THE SIZE OF** a typical suburban home, hollow it out, bash an entrance and some ventilation holes into it with a sledgehammer, and have people move right in? That would be a time-saver, for sure.

In fact, brick sizes do vary, though the overriding constraint is that a brick must fit readily into a bricklayer's hand, which rules out the one-brick-abode idea, and ensures that he is able to deploy said brick upside the head of anybody who would suggest such a thing, no matter how much sense it might make after a couple of beers down at the POPULAR MECHANICS Pub.

Turns out that bricklaying is both art and science, with the science originating in a motion study performed in the early 1900s by Frank and Lillian Gilbreth, who sought to optimise this repetitive task by identifying and eliminating inefficient techniques. Thanks in large part to the Gilbreths' analysis, an experienced, modern-day mason can lay as many as 2 700 bricks a day using their method. That's thought to be as good as it's going to get, productivity-wise. So back to the question: if 2 700 a day is the cap, why not make each brick larger, thereby covering more territory?

To some extent this has happened, for reasons of both

efficiency and aesthetics. Larger buildings, for instance, can look downright silly if they're constructed with regular bricks. Still, standard, or modular (as they're known to those wise in the ways of bricks, like Brian Trimble, regional vice president of engineering services at the Brick Industry Association), bricks continue to dominate the trade. The term modular derives from the fact that construction practices have for the most part been standardised around modules of certain sizes – a common one is 100 mm. That means that, ideally, measurements and components in a design should all be multiples of 100 mm, which cuts down on the amount of costly custom fabrication required. A standard mortar joint is 10 mm. Each modular brick is 190 mm long. Do the math and what do you get? The magical multiple of 200 mm. Sure, you could make a 300 mm brick or even a 400 mm, but by that point they tend to get so heavy that they may violate union rules and pose a threat of repetitive-stress injuries, to say nothing of injuries to writers who dare challenge the established order.

If the Earth is rotating at about 1 450 km/h, why can't I get in a helicopter and rise up 600 metres (to avoid buildings), wait about a few hours, and then set down in Brazil?

Why don't high divers consistently miss the pool, which ought to rotate out from under them while they're in the air? Why doesn't your dog end up in your neighbour's tree every time it leaps to catch a Frisbee? Why is an unrelenting 1 450 km/h wind not peeling the face off anyone crazy enough to venture outside without the protection of a space helmet? Because, you see, we're all along for the ride on

this crazy planet we call Earth.

The planet and everything on it – divers, dogs, giant hollowed-out bricks – are always rotating together at the same rate, so in relative terms, we're all standing still. That includes the atmosphere. Take off and hover in a chopper and the Earth spins, you spin, the sky spins, the helicopter spins, and in the end you're still where you started relative to the ground below. So the next time someone accuses you of slacking, remind him or her that while it might appear to the untutored eye that you are reclined inert on the sofa with a cooler at the ready and your feet propped up on a giant wheel of cheese, you are actually moving through your day at a very brisk and undeniably productive 1 450 km/h.

Is there any way to capture the gigawatts of energy in a lightning strike for power generation?

Certainly there has been informal research. Typically, it has involved exposed ground, a 9-iron, and a lightly browned corpse in a stupid-looking visor and spiked saddle shoes. But here's the thing: whereas lightning is excellent for lighting up golfers, climbers, park rangers, and their outdoorys ilk, it is far less efficient at lighting your handsome new single-brick residence. In 2007, one startup company did experiment with a so-called lightning farm in Texas, but soon ditched the idea as unworkable. That's because there's a big difference between power and energy. A common lightning bolt contains about 1 billion joules of energy, enough to light a single 60-watt bulb for two months or so, though most of that is lost to things like its own thunderclap and the warming of the air around it.

PM

GREAT STUFF



LENOVO YOGA TABLET 2 PRO

Hold. Stand. Tilt. Hang. Project.

When you normally think about a tablet, I bet a home theatre experience is the last thing you have in mind. The first standout feature of Lenovo's Yoga Tablet 2 Pro tablet is without a doubt its whopping 34 cm Quad HD (2560 x 1440) IPS display. Next, you can't help but notice the incorporated Pico projector capable of displaying a 16:9 high resolution image on to any surface for an instant 50" theatre experience. Don't for a second think it's a gimmick – at the recent product launch in Johannesburg, about 50 journalists and guests sat comfortably on beanbags and watched the entire presentation emanating from the tablet. And yes, we could all clearly see what was going on. To complement the visuals, it also comes with an 8-watt sound system with subwoofer to deliver an unmatched listening experience. Seriously impressive stuff.

Like previous models, its unique kick stand provides four ways for you to enjoy media content; hold, stand, tilt or hang. Intuitive software automatically recognises the current user mode to optimise display contrast, brightness or sharpness, or turn on Dolby audio mode for watching movies or video chatting. It also boasts an impressive battery life of 15 hours from a single charge. Other features include Android KitKat operating system, 2 GB LPDDR3, Intel Atom Z3745 processor (2M cache, 4 cores, up to 1,86 GHz) and 32 GB on-board storage (expandable to 64 GB). Price: about R9 000. Visit www.lenovo.com/za





SENA GP10 BLUETOOTH AUDIO PACK FOR GOPRO

Add audio on the fly

Until now, adding quality narration to your latest action-packed adventure meant spending time fiddling with editing software after the fact. Happily, Sena's GP10 Bluetooth Audio Pack for GoPro action cameras makes including live audio a much more seamless and intuitive process. Featuring a specially designed adaptor for the GoPro Hero 3 and Hero 3+, it allows you to dump the standard wired microphone and work up to 100 metres away from the camera. The camera's internal microphone can still be used to capture natural ambient noise while you record voice audio at the same time. Plus, when using headsets with built-in intercom capabilities it allows multiple individuals to add their commentary. The end result: YouTube videos everyone will want to see. Price: about R1 250. Contact Action Gear on 011-781 1323 or visit www.actiongear.co.za



ENERGIZER 2 IN 1 LED STANDING LIGHT

Make light of blackout blues

Whether you're camping out, or navigating your lounge in the dark (thanks Eskom), Energizer's new multipurpose 2 in 1 LED standing light is extremely handy. Featuring foldout legs, light panel and a swivel torch-like head, it can shed light exactly where it's needed. Powered by 4 AA batteries, it has 4 Nichia LEDs to deliver 100 lumens (spotlight mode), has a run time of around 10 hours and is weatherproof. Price: about R380. Contact Energizer on 011-802 2424 or visit www.energizer.co.za

ECORIDER NINEBOT PERSONAL TRANSPORTER

Smoothly does it

Move over Segway: the Ninebot's in town. Smaller and lighter than the iconic personal transporter we all know so well, EcoRider's Ninebot personal transporter incorporates Tesla Model S super lithium battery cells, said to be 50 per cent more powerful than the norm. A 2 to 4 hour charge gives you a range of at least 20 km. Small enough to fit through doors and weighing 23,5 kg (thanks largely to its magnesium alloy skeleton), it's unbelievably easy to ride – lean forward and you go, lean back and you slow down, stand up straight and you stop.

It also comes with a remote control allowing you to, for example, limit its top speed of 20 km/h to something more appropriate for when your children want to have a go.

For every main system component there's a duplicate backup should the main part ever fail, making it extremely safe to operate. The on-board digital display panel allows riders to monitor basic functions while on the go. There's a USB charging port to accommodate extra lights and accessories and it's fitted with 16" Michelin tyres, resin steel composite hubs and Bayer rims and spokes. Price: about R45 000. Contact EcoRider on 021-836 5363 or visit www.ecorider.co.za





ACER LIQUID JADE S

Say Cheese

Does social media get you all atwitter? If so, then Acer's Liquid Jade S 4G LTE (Cat 4) smartphone could work for you. More sophisticated than its predecessor, the Liquid Jade, it boasts improved front and rear voice-activated cameras, a more powerful 64-bit octa-core processor and impressive download speeds of up to 150 Mbps.

Activating the rear 13 MP camera (with its fast f1.8 aperture lens) is as simple as saying "Cheese". Want to capture the perfect selfie on its front-facing 5 MP camera? Just say "Selfie" to switch cameras. A particularly cool new feature is Dual Shot, which lets you make a collage of simultaneous shots from the front and rear cameras for picture-in-picture and video-in-video. Intriguing, but possibly less useful, is Gourmet Mode, which enhances food images shared via Instagram.

The fashionably slim curved ergonomic chassis, only 7,78 mm thick, features a 5" IPS LCD capacitive touchscreen and 2 GB RAM. You also get free offline navigation, allowing navigation without trashing your data plan at home or abroad. Price: about R4 200. Contact Acer on 0861 223 772 or visit www.acer.co.za

CANON LEGRIA HF R68 CAMCORDER

Memory maker

We can all whip out our smartphones and shoot some video, but what if it's a special occasion and you need something more capable? That's where Canon comes to the party. Their new Legria HF R68 camcorder lets everyone capture family and holiday moments, creatively, in Full HD. Its 32 x optical zoom lens (35 mm equivalent: 32,5 mm – 1 232 mm) gives you the freedom to shoot a diverse range of scenes and subjects near or far. It comes with a wide angle lens (26,9 mm) attachment for those moments when you want to fit the entire extended clan into the frame or capture panoramic vistas while on holiday.

Numerous easy-to-use recording modes, such as slow and fast motion and time lapse, help add creative twists to your movie making. Plus, there's no need to stress about camera shake, even when you're on the move – 5-axis optical image stabilisation takes care of all that. Even better, Wi-Fi and NFC connectivity allow you to upload footage to smart devices and social media sites directly. Price: about R4 300. Contact Canon on 011-251 2400 or visit www.canon.co.za



TOMTOM GOLFER GPS WATCH

Get into the swing

Fanatical golfers wanting a leg up on their opposition should check out TomTom's all-new Golfer GPS sports watch. Unique course graphics clearly show accurate distances to hazards and layups. More than that, though, it shows you the best approach to the hole (including precise yardages to front, centre and back of the green) far better than any caddy could. It even uses GPS technology to recognise nearby courses and find the next hole – automatically. Course data from over 34 000 golf courses around the world is available and updates are delivered wirelessly via a smartphone app. Keep track of your score, distance and time of round without any hassle thanks to this lightweight, slim and weather- and water-resistant device. Price: about R4 000. Visit www.tomtom.com

PARROT BEBOP AND SKYCONTROLLER BUNDLE

Eye in the sky

You can fly Parrot's new Bebop drone with your phone or tablet, if you want to. But why bother when you can hook it up to its handy companion, the Skycontroller? In turn, you will be able to connect a variety of FPV (first person view) headsets to deliver a completely immersive experience.

The Skycontroller has a lot going for it. Its adjustable cradle accommodates most tablets and smartphones. Equipped with an amplified Wi-Fi 36 dBm radio and four antennas, it extends the flying range up to 2 km. An HDMI port lets you plug in a headset and soar through the clouds (visually, at least) in real time. And let's not forget the two joysticks that take the hassle out of flying via touchscreen.

Safety took high priority in the Bebop drone's design. In the event of a collision the spinning props stop automatically. Hit emergency mode and it lands automatically. Its homing function kicks in either automatically or when you press the dedicated "get back here" button. And clip on outer shrouds make it suitable for flying indoors. On-board sensors include GPS, 3-axis accelerometer, gyroscope, magnetometer, ultrasound (with 8-metre reach) and vertical camera (to track speed). Optics wise, you get a 180-degree 14 MP fisheye lens with full digital 3-axis image stabilisation – allowing you to capture smooth HD footage. Expect to pay about R13 500 for the bundle. Contact Yuppie Gadgets on 021-593 0000 or visit www.yuppiegadgets.com



● READER COMPETITION



BLACK'S THE WORD

A secret speakeasy basement tryst awaits a select few

Word on the street is that there's something up with famous Scotch whisky Black Bottle – and it's all got to do with the new look and taste.

Black Bottle has conceived a most unusual introduction to these developments. Guests take the clandestine route to The Black Bar in the basement of an iconic and historic club in Cape Town. After being covertly screened by someone known only as Mr McLeod, they just may be admitted.

Their rendezvous includes words with the very sassy lady of the house, Miss Ruby, followed by exposure to Mr Black, the key narrator of the Black Bottle story. They also encounter mixologist Don Sheehan before a rather surprising end to the whole affair.

HOW TO ENTER: Go to www.popularmechanics.co.za and fill in the required details. Follow Black Bottle on Facebook (<https://www.facebook.com/BlackBottleSA>) and/or Twitter (<https://twitter.com/BlackBottleSA>). Join the conversation using: #BlackBar Visit www.theblackbar.co.za

READER
EVENT

WIN one of **10** sets of double tickets to join POPULAR MECHANICS at a Black Bottle whisky tasting experience.

DATE: 17 April 2015 (Friday)

TIME: 18h30 for 19h00

VENUE: The Black Bar

FIND BEAUTY BEYOND THE OBVIOUS. FIND BLACK BOTTLE

This give-away is open to South African residents over the age of 18. The promotional competition commences on 23 February 2015 and ends on 23 March 2015. Entries received after the closing date will not be taken into consideration. Winners will be determined by random draw at the close of the competition and notified by email no later than 27 March 2015. This give-away is open to South African residents over the age of 18. Please go to www.popularmechanics.co.za and/or www.facebook.com/BlackBottleSA (or both) to view the full terms and conditions associated with this give-away.



BLACKBEARD REPLICA LES PAUL 1 GUITAR KIT

Legend in the making

When Gibson launched the Les Paul guitar back in 1952, the company changed the music scene forever. And, thanks to the likes of Jimmy Page, Eric Clapton, Gary Moore and Bob Marley (not to mention the creator, Les Paul himself), it's been inspiring aspirant musicians and aficionados ever since. Guitarists wanting some of their own classic action should check out Blackbeard's Den's Replica Les Paul 1 DIY guitar kit (model EG LP 10).

Building the kit is easy – all that's required are a few basic tools. The guitar body is made out of solid mahogany with a spalted maple top. The neckboard with headstock is made out of the same two materials and includes rosewood for the fretboard. Plus, there's enough extra wood around the headstock for you to shape your own design should you want to. You also get all the hardware (pickups, knobs, etc.) in black, which compliments the mahogany nicely, along with a detailed assembly guide and ongoing build support. Price: about R2 700. Contact Blackbeard's Den on 082 9294 719 or visit www.blackbeardsden.co.za



RUNTASTIC ORBIT FITNESS TRACKER

Get fitter faster

Runtastic's Orbit Fitness Tracker can't stop you from eating cake, but it can alert you to the consequences. It tracks steps, active minutes, calories burned, sleep cycles, goals and ambient lighting. Other features include a white OLED display (easy to view, even in bright sunlight), time (with alarm) and Bluetooth connectivity. It's also waterproof to 100 metres. The Orbit's tracking capabilities and data output are enhanced by the compatible Runtastic Me app, which syncs wirelessly with the unit. Activities and data can be saved for up to a week and, with the click of a button you can even keep track of your mood. It comes standard with blue or black colour options, along with a clip for wearing it on a belt or bra. Six additional coloured wristbands are available. Price: about R1 800. Contact Wintec Solutions on 011-467 2360 or visit www.wintecsolutions.co.za

KANEX MULTI-SYNC KEYBOARD FOR MAC/ IPHONE/IPAD

Take multitasking to a new level

Juggling three different devices at once (think computer, tablet and phone) can be a pain. Fortunately, if you're an Apple user, there's a solution. The Kanex Multi-Sync Keyboard for Mac/iPhone/iPad lets you work between all three devices at the push of a button; reply to a text on your phone, take notes on your tablet or type away on your computer. Bluetooth connectivity takes the pain out of connecting multiple devices and removes any need for multiple USB ports. An adjustable stand allows you to prop up your iPhone or iPad at a convenient angle for easy viewing. It'll also work as a generic full-size keyboard for Windows PCs, but, understandably, some functionality will be lost. Price: about R900. Contact Mantality on 011-462 5482 or visit www.mantality.co.za



PM



Innovation
that excites



NEW NISSAN JUKE. TESTED TO THRILL

You feel the hair on the back of your neck begin to stand. Your eyes sharpen as your pupils dilate. Your heart begins to race. You're in the new, bold Nissan Juke. Your online world travels with you, thanks to NissanConnect, and the confident, responsive range of engines lets you know that this isn't just a drive; it's a thrill.

Available in 1.2 Turbo, 1.5dCi and 1.6 DIG-T engines.

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THE INCREDIBLY SPECIAL EFFECTS AWARDS

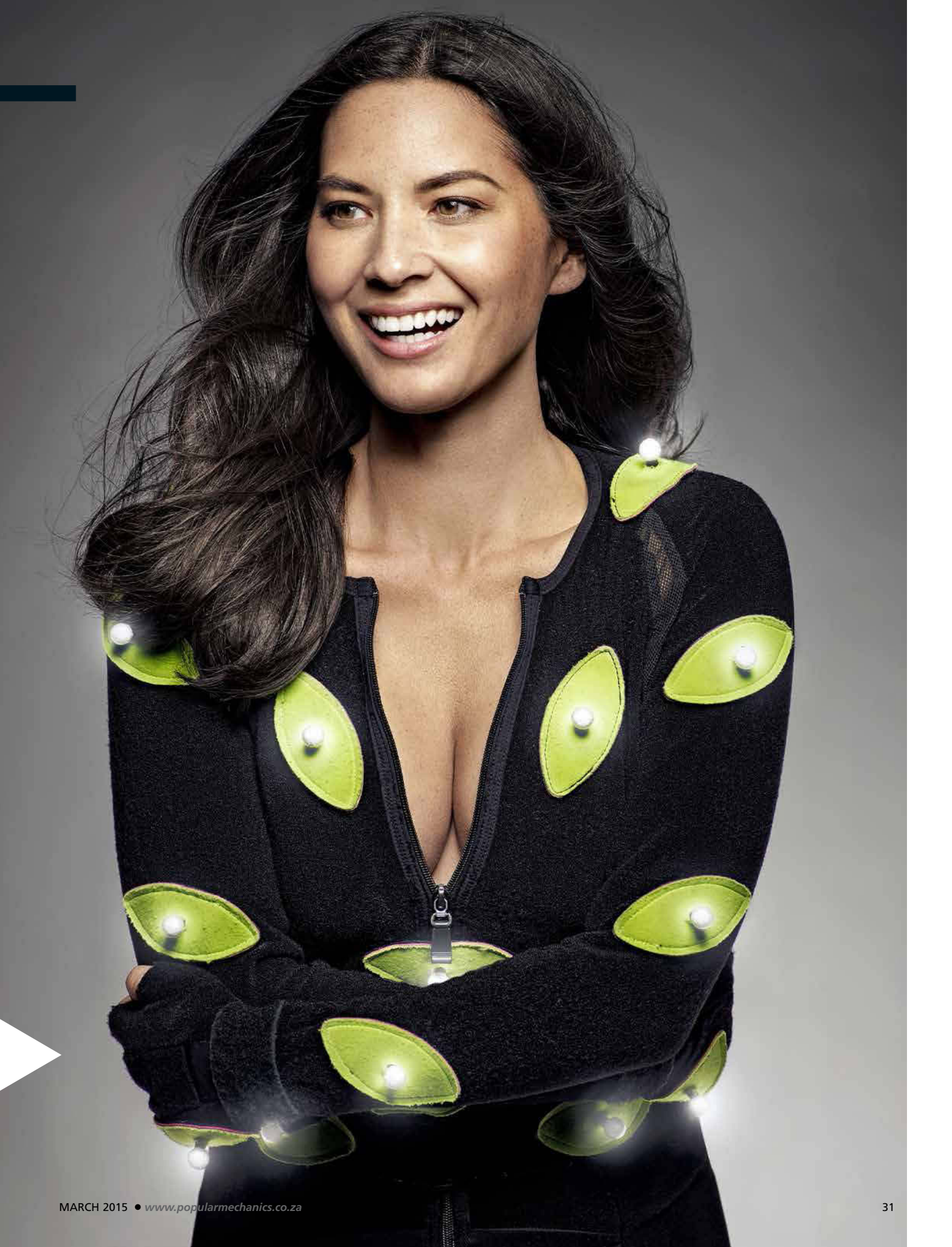
BY TIM GRIERSON AND
LAUREN BANS
PHOTOGRAPHS
BY ART STREIBER

WE LIVE IN A GOLDEN AGE OF CINEMATIC INNOVATION. EVERY YEAR THE EFFECTS INDUSTRY - AND IT IS AN INDUSTRY - INVENTS NEW TECHNIQUES, SOFTWARE AND ON-SET GADGETRY THAT ALLOW FILMMAKERS TO TELL THEIR STORIES IN VISUALLY STAGGERING WAYS. OVER THE NEXT PAGES, WE SALUTE THE YEAR'S MOST STUNNING TECHNOLOGICAL MOMENTS IN FILM, INCLUDING MINIATURE HOTELS, DIGITAL ALIENS, LOTS OF FAKE BLOOD AND MICHAEL KEATON.

With your host, Ms OLIVIA MUNN, star of screens large and small, former tinkerer, the funniest person in *The Newsroom*, and the best reason to see *Mortdecai*, the most strange and wonderful movie of 2015.

TYPOGRAPHY BY JEFF ROGERS

www.popularmechanics.co.za • MARCH 2015



THE
INCREDIBLY
SPECIAL
EFFECTS
AWARDS

BEST SCALE SHIFT

The Grand Budapest Hotel

In Wes Anderson's *The Grand Budapest Hotel*, intricate miniatures were built to give a sense of the hotel's magnificence. According to production designer Adam Stockhausen, Anderson envisioned a "hotel that sits on a hill that is not reachable by the regular train. Miniatures happened to be stylistically appropriate to the handmade quality of this film – plus, it allows for a hands-on control of the process and a very physical product." The wood-and-paper mini hotel took a few months to build. "For the details," he says, "they cast repeatable parts. All that window and door detail – they would make one, mold it, and then cast multiples out of resin." The resulting model is striking, like an immaculate relic from a more civilised time.



Russell Crowe in *Noah*.

BEST STORM

Noah

Ben Snow, visual-effects supervisor, on creating the chaotic flood scene:

▲ "The Bible says that the waters shot from the ground, so we filmed geysers in Iceland as a reference to create our own CG versions, then added details like mist and spray. For the first wave of the flood, a water simulation helped us create a big wave coming from all sides like a doughnut. Then there were 400-litre dump tanks and water cannons that we actually fired at the stunt guys trying to climb aboard the ark. Oh, and Hurricane Sandy hit when we were filming. We had to shut down for 10 days. That was sort of ironic."



And the Andy Serkis award for achievement in motion capture goes to... *Andy Serkis in Dawn of the Planet of the Apes*

One great scene in *Dawn of the Planet of the Apes* – a battle between Caesar (Serkis) and Koba combined existing motion-cap effects with a stunt element straight from *Titanic*. Dan Lemmon, a visual-effects supervisor with Weta Digital who worked on both films, explains: "When the

Titanic was sinking, people fell and bounced off of things. That was done largely by using motion capture as a reference and adding digital framing on top. These days, with advances in the kinds of stages and in the stunt rigging, you can get much of the physical stuff in a capture session.

In the scene in *Dawn*, bombs go off and things explode and start falling over. We got to do tons of stunt work on the motion-capture stage where we'd flip guys around and throw them off heights and bounce them off poles and things. They loved it."

► GLOSSARY OF TERMS ✖ **Blue/green screen:** A way of digitally replacing a filmed background. Specific colour choice



AWARDING THE
AWARDERS
THE BEST-
EVER HOSTS
OF THE
ACADEMY'S
SCIENCE AND
TECHNOLOGY
OSCARS



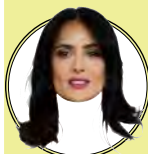
KRISTEN BELL
2014



JESSICA
ALBA 2008



SCARLETT
JOHANSSON
2005



SALMA HAYEK
2000



TOM HANKS
1992

Slaying of the year

Gone Girl

When Amy surprises Desi with a mid-coital slash across the throat, his blood pours out like a mall fountain. "We used a pneumatic-plunger system," cinematographer Jeff Cronenweth says. "The blood ran up the back of his leg and across through a prosthesis into his neck." The only issue was the ensuing mess – made worse by the fact that director David Fincher is notorious for wanting multiple takes. "Every time it happened it would take about two hours to do cleanup," Cronenweth says. "You have to get the blood off the actors right away, or eventually their skin would start turning pink. You have to change the bedding and clean the furniture and the carpet. We did about 12 takes altogether."

depends mostly on what an ›

BEST ALIEN (HUMAN EDITION)

Under the Skin

Most movie aliens don't look like Scarlett Johansson. The one in *Under the Skin* didn't either, at first. "We tried false teeth and things like that, but in the end we decided not to touch a thing," says senior special-effects supervisor Mark Curtis. Instead the shock of her alien-ness comes in the finale, when her human disguise gives way to her featureless black self. "We had to create a replica skin of Scarlett," Curtis says. "We took a full-body scan from her, and one from the actress who was going to wear her skin. We converted Scarlett's data to a computer-controlled machine, which basically milled out the shape of her body in plasteline. We added in all the detail and it was then dressed onto the 'alien' actress after she was body-painted black." ▼



Scarlett Johansson
sheds her human form
in *Under the Skin*.

BEST ALIEN (ALIEN EDITION)

Edge of Tomorrow

Edge of Tomorrow production designer Oliver Scholl and his team started by answering some basic anatomy questions: "Is this going to be humanoid or some 12-legged, tentacled thing?" They considered various incarnations until visual-effects supervisor Nick Davis suggested a different approach. "He said, 'Rather than what it looks like, let's think about how it actually moves and how we're gonna battle it,'" says Scholl. "That gave us this idea that there's no front and back, there's no directional sense in the creature." The result is killing machines. "You just remember them as these dervishes of tentacles that are flying across the beach." ▼



An alien Mimic in
Edge of Tomorrow.

BEST MAKEUP

Foxcatcher

When director Bennett Miller approached Oscar-winning makeup artist Bill Corso to transform Steve Carell into troubled blueblood John du Pont, he had one instruction: "He needs to be a completely different human being." The process involved several steps.



▲
BEFORE



2,5 hours in the
makeup chair

▲
AFTER

1

The Nose

After creating a life cast of Carell's face, Corso made multiple shapes of possible noses out of clay. "Du Pont was known as the Golden Eagle," Corso says, "so I gave him this eagle-like nose."

2

The Skin

The hardest step was altering Carell's complexion. "Steve has a swarthy, Mediterranean skin tone," says Corso, "and Du Pont is pale, translucent. Painting Steve's skin took longer in the makeup chair than even putting on all the rubber stuff."

3

The Mouth

Du Pont had a distinct way of holding his mouth and a very soft lower lip," recalls Corso, "and Steve has sharp, perfect lips. When Du Pont talked, his lips rounded in a way that's so different from Steve's," so Corso gave Carell a fake lower lip – "almost a whole fake chin" – and added plumpers "to fill the lower part of his face out." Also, the teeth had to be addressed: "Steve has big, white, movie-star teeth, and the real Du Pont had tiny little grey teeth – like rat teeth almost, which is surprising for a man of wealth."

4

The Face

Carell's face is narrower than Du Pont's, so Corso shaved his hairline to emphasise his forehead. To minimise his eyebrows, a cover was placed over them. "We toyed around with the idea of shaving them off, but Steve was starting *Anchorman 2* right after we finished."

THE SHOESTRING BUDGET AWARD

Siddharth

Richie Mehta's *Siddharth* was shot in 21 days with a budget of only R300 000, which limited him to only a few takes per scene. ("We didn't really have permits," says cinematographer and visual-effects artist Bob Gundu.) So Mehta and his team allowed Delhi's unpredictable hustle and bustle to create atmosphere around the characters. They didn't use extras,

just passersby – and a little creative editing. "There'll be that one take that looks great, but then you look in the background and someone's staring at the camera," notes Gundu. Instead of reshooting, "We would use the head from the previous take and slap it onto this one." In all, Gundu did nearly 50 eye and head replacements. ▼



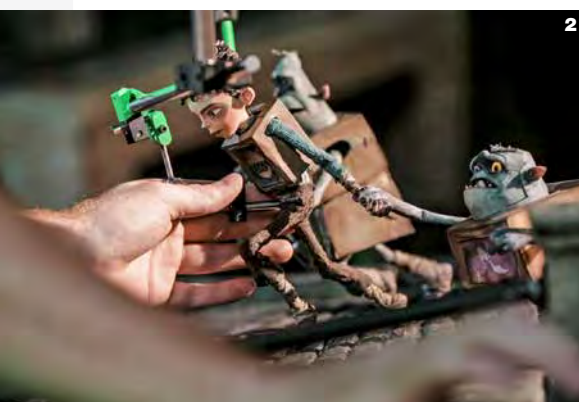
THE INCREDIBLY SPECIAL EFFECTS AWARDS

How to make a Boxtroll

1. The faces are attached with magnets. More than 53 000, each with a different pose, were used in the movie.

2. The 23 cm metal-and-silicon puppets are positioned, then a picture is taken. The puppet is moved ever so slightly, then another picture is taken. And so on.

3. Working fulltime, each animator created only 4 seconds of film a week.



Achievement in stop-motion animation

The Boxtrolls

Laika animation studio's *The Boxtrolls* used a traditional technology stop-motion animation – in a highly modern way. Brian McLean, director of rapid prototype, was responsible for creating the faces: “We model and animate them on the computer,” he says, “and then print them on the 3D printer.” ▲

LONGEST PRESUMED TAKE

Birdman



Director Alejandro G. Iñárritu's greatest trick in *Birdman* is creating the impression that the entire movie is one continuous shot. And it's a trick he plans to keep secret. “Part of the difficulty of being an editor is you never talk about the work you actually did,” co-editor Stephen Mirrione explains. “It's a bit of doctor-patient confidentiality.” He and coeditor Douglas Crise will acknowledge that Iñárritu rehearsed with his cast for weeks before

the shoot, filming the sessions so that he could experiment with the best places to make invisible cuts and add imperceptible pauses within the action. For those who welcome frustration, Mirrione offers this titbit: “In a general sense, some takes are longer than you would believe possible. And some of them have more cuts in them than you could ever see or imagine.”

actor is wearing. **Special effects:** Physical simulations performed on-set. >

THE
INCREDIBLY
SPECIAL
EFFECTS
AWARDS

Best analogue effect

Boyhood

Richard Linklater's film was shot over 12 years. The characters' ageing was the result of time, not makeup.



Actor Ellar Coltrane, first year of filming



Three years in



Twelve years in

BEST (FAKE) SEX SCENES

Nymphomaniac

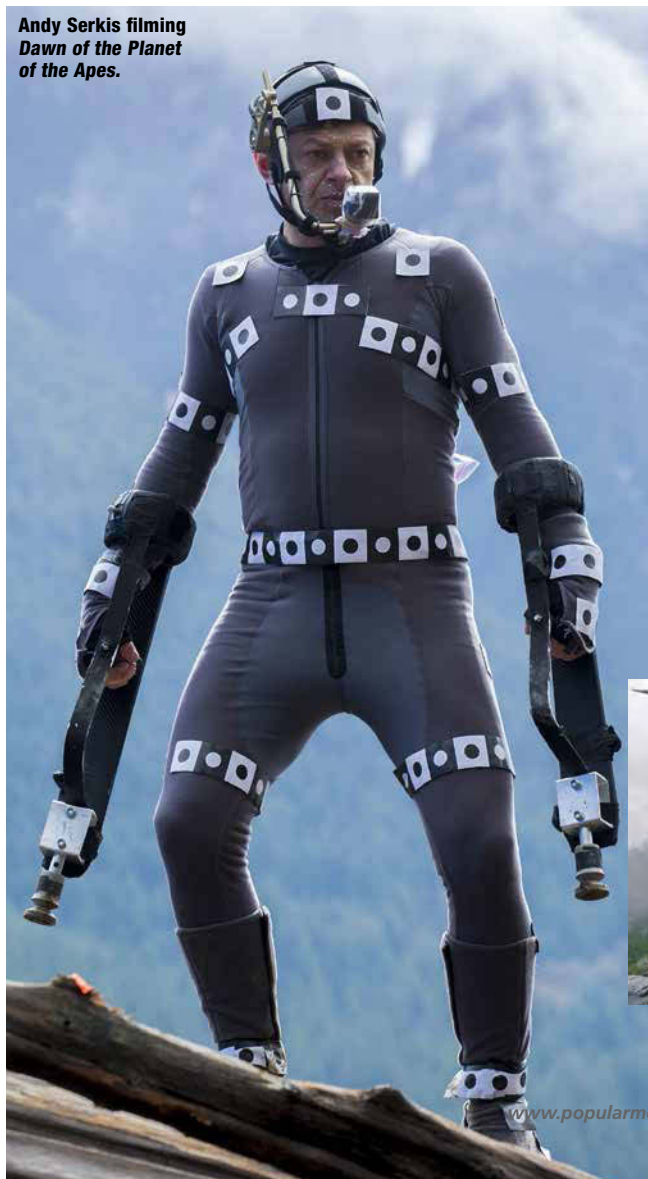
In Lars von Trier's *Nymphomaniac*, Hollywood stars seem to be engaging in explicit on-camera sex. But it was actually a computer-enhanced trick: According to the movie's visual-effects supervisor and second unit director, Peter Hjorth, the actors' movements were combined with that of porn doubles, using a little CGI where necessary. "We had some very basic performance-capture points on the actors' bodies and maybe a witness camera, so we would know the spatial relationship between them. Then I would work with porn doubles to replicate that. We'd shoot that and then we would find the best match, merging them in postproduction."

Most inventive prosthesis

Dawn of the Planet of the Apes

▼ Terry Notary, the film's lead ape co-ordinator, spent six weeks in his garage developing arm extensions to make "quadrupedding" easier for the humans playing apes in the movie and to make the movement look more realistic on film. The extensions, which are welded from aluminium and have high-performance, pivoting rubber crutch stoppers at the toe, allowed the actors to "jump over things like cars and land on their hands," Notary says. And apparently they're super-easy to get the hang of: "Once you get comfortable you want to be on them all the time."

Andy Serkis filming *Dawn of the Planet of the Apes*.

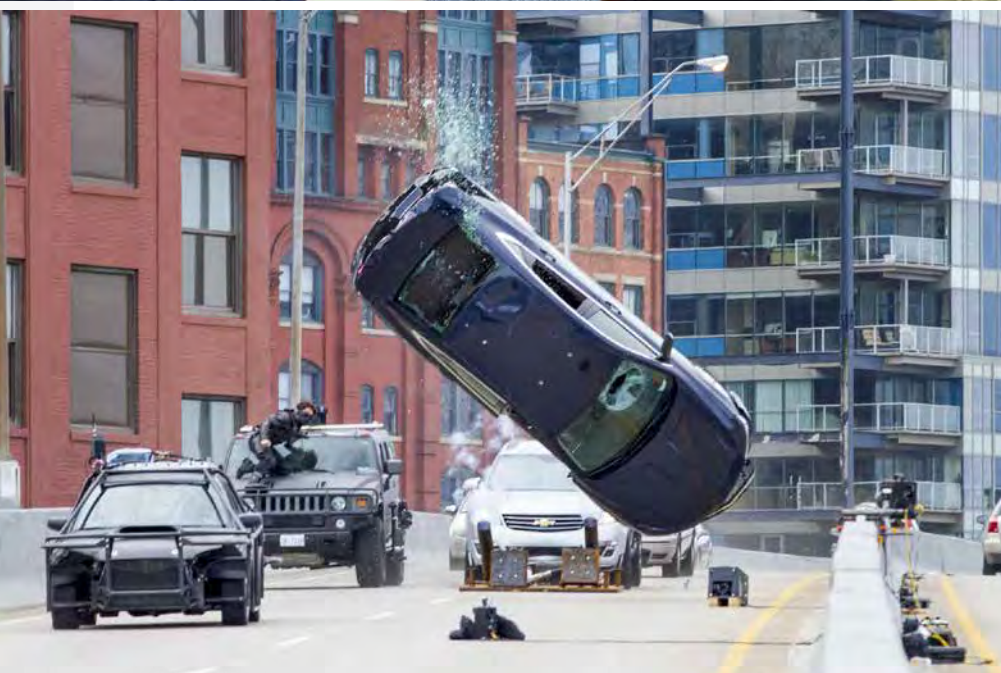


After a short time wearing the ape arms, "you feel like they're a part of you," Notary says.





The crew maps out the chase.



BEST ACTION SEQUENCE

Captain America: The Winter Soldier

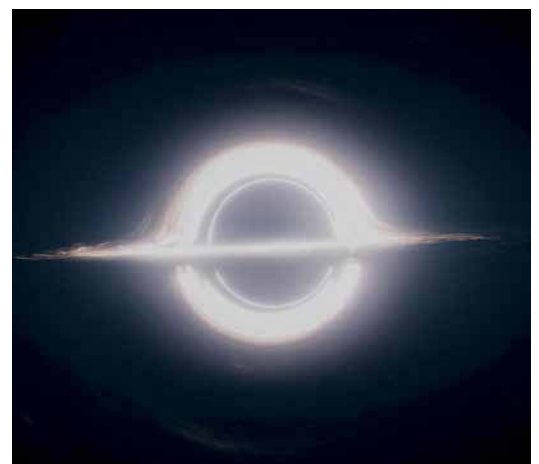
◀ Spiro Razatos, the film's second unit director and stunt co-ordinator, explains how Nick Fury's race through downtown DC came together: "The directors [Anthony and Joe Russo] had seen a chase in Brazil, a real car chase. This guy went from light traffic, where the cops were chasing at high speeds, to heavy traffic, where he had to work his way in and out and back up into cops and motorcycles. They said, 'We want this thing to start off with some speed and then we want it to get to the point where all hell breaks loose and he doesn't have anywhere to go.' Usually, it's speed or destruction, but in this chase scene it was more about congestion with people and all the chaos. They wanted this to be real. "The guy getting hit into the bus stop, the guy getting backed into... All that stuff, the rehearsal, it takes months. The bus stop is my favourite part. We had that car on a ratchet system, meaning that the car would swing in exactly the same way each time. We started off easier. We put an 8 cm pad across the car, it got pulled in slowly, and the stuntman took the hit. We did that until he got the timing down, and then we took the pad off the car, put the people in there, and put in the real glass."

ACHIEVEMENT IN SCIENTIFIC ACCURACY

Interstellar

Theoretical physicist Kip Thorne has consulted on many films, but usually after they've been shot, when producers want someone to validate what's already there. That wasn't the case with Christopher Nolan's *Interstellar*. Thorne met with Nolan and his brother (and co-writer) Jonathan early in the process to discuss possible plot points for scientific validity. As for one of the major features of the film, the black hole, "we have lots of observations on them," Thorne says. However, "The warp drives and wormholes are speculation. We have no proof that they can occur, but since we can't rule them out, in my view they are acceptable devices for a science-fiction movie." To Thorne's mind, the question of scientific accuracy isn't as important as helping people understand that not all science is the same: "Having a film that includes speculative science, as well as established science, gives me an opportunity to try to convey to a general audience the difference between the two and give them some sense of how – as we collect more data, more observations, more experiments – we may transform speculation into educated guess, into truth." ▶

Visual effects: Postproduction digital manipulation of footage. **Mo-cap:** Short for motion-capture, the process of ▶



THE
INCREDIBLY
SPECIAL
EFFECTS
AWARDS

Best green screening

Mortdecai

Director David Koepf explains: "The more you mess up green-screen images the better. When we're moving and the object is moving, our eye is used to seeing things in a blurry, bouncy way. Shaking or



vibrating the camera helps, as does de-focusing and lens flares. In this frame the car wasn't moving, but others required it to be moving quickly, in which case you need very secure cabling to make sure you don't send your lead" – in this case Johnny Depp – "bouncing off onto the sidewalk."

And now a few words from your host...

Olivia Munn has been charming comedy fans and gadget enthusiasts since she first appeared on *Attack of the Show*, the cult-hit news and technology review on the channel formerly known as G4, in 2006. Since then she's played a fake journalist on *The Daily Show* and a real journalist on *The Newsroom*. She currently stars alongside a very moustachioed Johnny Depp in the action-comedy *Mortdecai*, which deserves its own special award (left), even if it didn't come out in 2014. She sat down with David Katz in Los Angeles to discuss.

POPULAR MECHANICS: This is a weird-looking movie.

OLIVIA MUNN: It's a comedy heist movie. Johnny Depp, who plays Charles Mortdecai, is a British man who's running out of money and selling off his possessions to keep up his lifestyle. I play a spoiled rich girl who hears about a special painting that could be worth a lot of money, so she goes out to steal it.

PM: Why would she steal it?

OM: Everyone's trying to get this painting. My character has a very strange moustache fetish, so that can derail things sometimes. There's definitely a scene with a horse.

PM: So this is slapstick.

OM: Grounded in reality.

PM: I read that you used to build things with your brothers. How many brothers do you have?

OM: Two. My older brother makes motorcycles, and my younger brother is an engineer. He recently went back to school for his master's in physics.

PM: Is this an affinity that you share? Are you mechanical?

OM: Yeah. My sisters were always doing makeup and curlers, and I wasn't interested in that. As early as I can remember, when we'd all be kicked outside for the summer, my brothers and I would make a huge fort and string out the electricity from inside and build an air-conditioning unit. In the winter we built igloos. We made them so perfect that we'd be sweating inside. For fun, occasionally we'd decide to do something like make our own batteries out of pennies. We'd just create.

PM: A battery made out of pennies?

OM: It's just a battery. You can charge like – we did something that lit up. Obviously it's easier to go buy a battery, but it was more the idea of it. A Survivor-man kind of thing.

PM: Since you're hosting our movie technology awards, I should ask if you've done any green-screen work.

OM: The biggest thing I ever did was for G4: "Avatar Thelma & Louise." In our skit, they actually survive, somewhat, and get turned into avatars. We had to do full blue makeup. I was blue for a long time. Blue in my ears, blue everywhere. But I did do my own stunts on *Mortdecai*.

PM: What kind of stunts?

OM: I learnt how to ride a horse. They told me I had to jump out of a storey-and-a-half window. They said, we've got a stunt double, but why don't you just see if you can do it?

PM: Did you like doing that?

OM: I grew up doing karate and gymnastics and everything, so there's a part of me that likes the challenge. Later I had to ride in on this horse at full gallop through a very narrow path and trees coming up over us and land literally on a dime and jump off the horse.

PM: Good enough for us.

PM



filming an actor in a jumpsuit adorned with reference points to capture natural movements and facial expressions. ✖

SONY



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The new waterproof* Xperia™ Z3 and Z3 Compact smartphones have up to two days battery life** and Sony Cyber-shot™ and Handycam® technologies for superior camera performance. It's the details that make the difference between good and great.



XPERIA Z3

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Xperia™ Z3

Xperia™ Z3 Compact

SmartWatch 3

*The Xperia Z3 and Xperia Z3 Compact are waterproof and protected against dust as long as you follow a few simple instructions: all ports and attached covers are firmly closed; you can't take the phones deeper than 1.5m of water and for longer than 30 minutes; and the water should be fresh water. Casual use in chlorinated pools is permitted provided they are rinsed in fresh water afterwards. No seawater and no salt water pools. Abuse and improper use of devices will invalidate warranty. The phones have an Ingress Protection rating of IP65 and IP68. The SmartWatch 3 is water and dust protected as long as you follow a few simple instructions: all ports and attached covers are firmly closed; you can't take the smartwatch deeper than 1.5m of water and for longer than 30 minutes; and the water should be fresh water. Casual use in chlorinated pools is permitted provided it's rinsed in fresh water afterwards. No seawater and no salt water pools. Abuse and improper use of device will invalidate warranty. The smartwatch has an Ingress Protection rating of IP68. To see what this means and for more information see www.sonymobile.com/durability. **Based on multiple battery performance testings conducted between July and September 2014 in a laboratory under active use conditions reflective of the Typical Smartphone User by Sony Mobile Communications AB. For more information: www.sonymobile.com/testresults. Icons and images are simulated and are for illustrative purposes only. Sony and Walkman are trademarks or registered trademarks of Sony Corporation. Android, Google Chrome and Google Play are trademarks of Google Inc. ©2015 Sony Mobile Communications Inc. All rights reserved.



LEADING THE CHARGE

THE QUEST FOR SUSTAINABLE MOBILITY SOLUTIONS IS CHANGING OUR WORLD. WE'RE ONLY JUST BEGINNING TO APPRECIATE HOW PROFOUNDLY ALTERNATIVE, NEW (AND MORE PLANET-FRIENDLY) METHODS OF PROPULSION IMPACT ON THE WAY WE WILL TRAVEL IN FUTURE. BUT ALTHOUGH CHANGE IS A GIVEN, IT'S *HOW* THAT CHANGE IS ACCOMPLISHED THAT REALLY MATTERS.

IN MUCH THE SAME WAY as the first motorised vehicles forever changed the way the world viewed its means of getting from A to B, electric vehicles are causing a radical shakeup in how we interact with modes of transport. Even within this new category of vehicles, though, key differentiating factors are becoming evident – and leading the charge towards innovative ways of using EVs is BMW i.

BMW has always been about projecting a premium sporty image; that's why the company says that in the modern world it stands for visionary vehicle concepts, inspiring design and a new understanding of premium strongly defined by sustainability. That sustainability is designed to extend right the way through the supply chain, from manufacture to vehicle operation.

In the BMW i3 – the first series-produced model by BMW i – zero-emission mobility in a premium car package also proves to be a recipe for pure driving pleasure. After all, it's just like other BMWs: it has rear-wheel drive, a low centre of gravity, balanced weight distribution and a specific suspension set-up to provide the perfect platform for agility and driving pleasure.

Yet it's the first BMW Group model running on electric power alone, providing new and groundbreaking ways to experience driving pleasure, sustainability and connectivity on city roads.



LIGHT, STRONG, SMART

The visionary design of the BMW i3 showcases both BMW's customary sporting capability and the efficiency of a four-seater. Its innovative vehicle concept, including a passenger compartment made from light yet rigid carbon-fibre-reinforced plastic (CFRP), combines lightness, stability and safety with extraordinary spaciousness. Meanwhile, the driver assistance systems and mobility services from BMW Connected Drive and the 360° ELECTRIC services – all developed specially for BMW i – turn zero-emission urban mobility into a compelling everyday driving experience.

The i3's unique vehicle architecture is based on the LifeDrive structure, with its CFRP passenger cell and aluminium module housing the BMW-developed powertrain, battery and chassis. The use of CFRP on this scale is unique in volume car production. In fact, the i3 weighs no more than a comparable vehicle with a conventional drive system and full fuel tank.

The LifeDrive architecture and BMW eDrive drive technology allow exceptional freedom in terms of design. For example, CFRP makes B-pillars and a centre tunnel unnecessary. Coupled with opposing "coach" doors, this allowed the creation of a spacious interior that belies the compact exterior dimensions.

The body design provides optimal protection not only for passengers, but also for the high-voltage battery. The battery is encased low down in the body, in aluminium sections, and is particularly well positioned from both a centre of gravity (hence agility) and from a crash safety perspective.

Tests conducted by the renowned DEKRA E-Mobility Competence Centre have shown that electric and hybrid cars with lithium-ion drive system batteries are at least as safe as vehicles with conventional drive systems in the event of fire. To ensure maximum safety in such a crash scenario, the high-voltage battery is disconnected from the high-voltage system and the connected components discharged when the passenger restraint systems are triggered. This safely prevents the possibility of a short circuit, which could lead to electric shocks or cause a fire. Three levels of safety, including a cut-off mechanism, for the car's software and hardware provide reliable protection for the electrical system as a whole.

>

ON THE CHARGE

The i3's special lithium-ion storage cells were developed in-house using the BMW Group's technological expertise in battery systems, as were control units and specific components that ensure the interconnection of the cells, as well as the connection between battery system and vehicle. Only the storage cells themselves are sourced



SPECIFICATIONS BMW i3

WEIGHT	1,195 kg
BATTERY PACK	lithium-ion, 8 x 12 cells, 230 kg
RATED VOLTAGE	360 V
ENERGY OUTPUT	22 kWh
MOTOR	hybrid synchronous
OUTPUT	125 kW/250 N.m
0-60	3,7 s
0-100	7,2 s
MAX SPEED	150 km/h
RANGE	130 – 160 km

The smart home-enabled BMW i Wallbox Pro system is one of the charging options available for the i3.



from a specialist manufacturer.

Those cells have an impressive energy density and cycle life and are designed to last the vehicle's entire lifespan. To maintain output and storage capacity over time, the battery management system controls both the charging and the discharging processes, as well as the operating temperature of the cells. However, it is possible to replace individual modules in the event of a fault.

The air-conditioning coolant is used to cool or warm the battery as required to its optimum operating temperature of around 20 degrees. The battery warranty is valid for eight years or 100 000 kilometres.

The BMW i3 is able to achieve a range of 130 to 160 kilometres in everyday driving. This rises by around 20 kilometres in ECO PRO mode and by the same distance again in ECO PRO+ mode. An optional 650 cm³ range-extender engine maintains the charge of the lithium-ion battery at a constant level and boosts range to as much as 300 km. Specifying the range extender has no effect on luggage capacity: the nine-litre fuel tank is located in the front section of the car.

When it comes to recharging, the BMW i3 is similarly flexible and efficient. Customers can charge their car from a conventional domestic plug socket or have a BMW i Wallbox installed by Schneider Electric (BMW i's charging installation partner in South Africa), which provides a potential charge time of

around six hours – even in its basic configuration. A modern public fast-charging station (50 kW) can boost the battery to 80 per cent capacity in half an hour.

>

POWER PLAY

The electric motor and transmission unit are located in next to the driven rear axle. The motor, developed exclusively for the BMW i3, features a specific arrangement and dimensions for the components used to generate drive that produces a self-magnetising effect only otherwise induced by reluctance motors. This additional excitation causes the electromechanical field formed by the current supply to remain stable, even at high revs. The hybrid synchronous motor (so named on account of its specific combination of properties) revs up to 11 400 r/min. Its innovative design principle helps it to run extremely effectively across a wide load band. This quiet-running, lightweight (just 50 kg) and efficient motor has led to the BMW i3 being viewed as the most economical electrically powered car of its size and output class.

One of the features that makes driving a BMW i3 such an engaging experience is its single-pedal control concept. Lifting off the accelerator immediately triggers Recuperation: the electric motor switches from drive to generator mode, feeding power into the lithium-ion battery. It also generates a pre-



Thanks to innovative construction that does away with B-pillar and centre tunnel, the roomy interior belies its compact exterior.

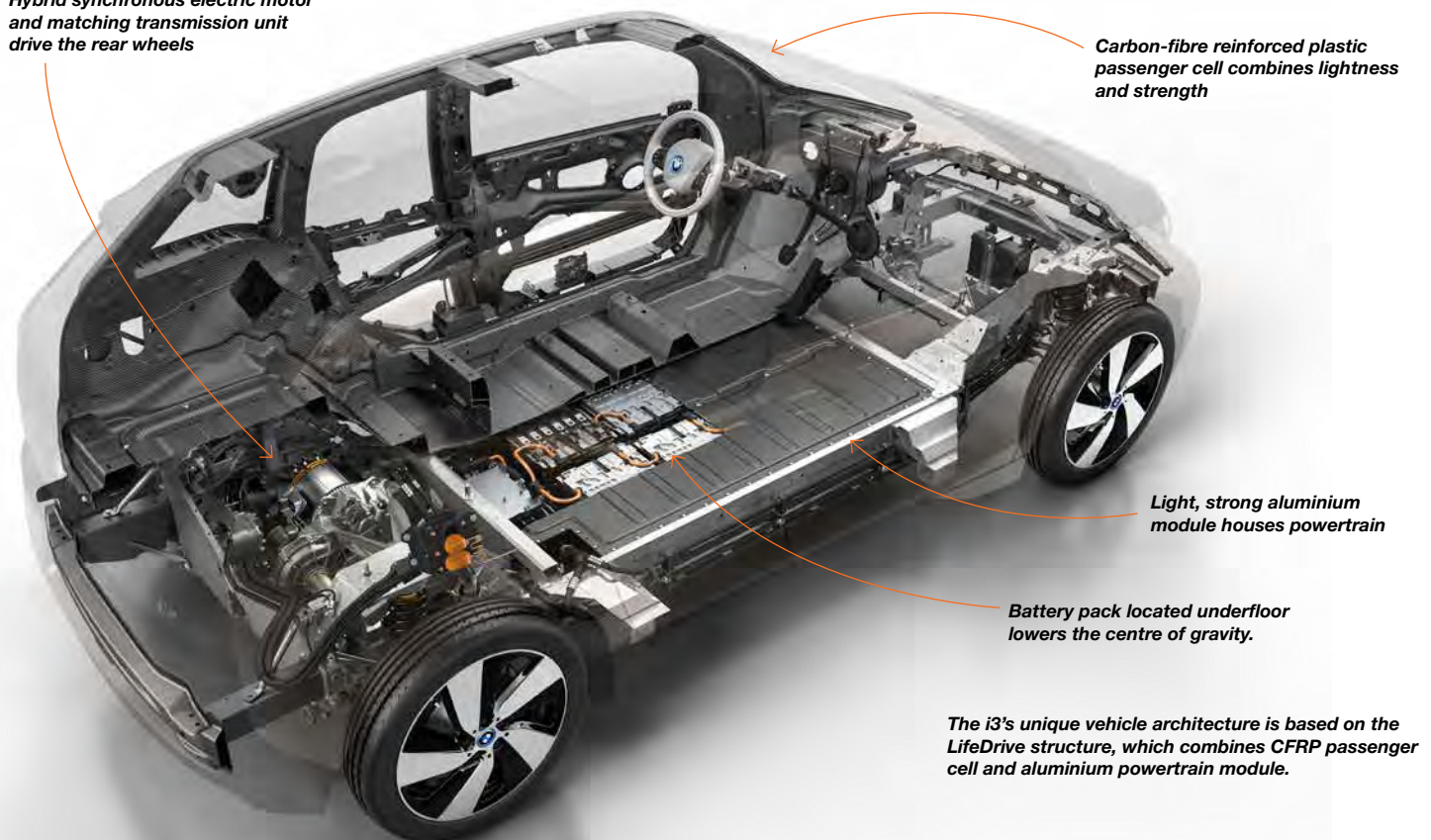
cisely controllable braking effect. This recuperation is speed-sensitive: the car "coasts" with maximum efficiency at high speeds and brakes strongly at low speeds. What this results in is a range increase of as much as 20 per cent compared with conventional recuperation concepts. The coasting effect simply makes it even more user-friendly.

>

FULLY CONNECTED

The BMW i3 is the world's first fully networked electrically powered car. No other model boasts such far-reaching exchange of information between the vehicle, its driver and the outside world. The key: a SIM card fitted as standard in the BMW i3, unlocking the BMW ConnectedDrive services available to the new electric model alongside familiar

Hybrid synchronous electric motor and matching transmission unit drive the rear wheels



Carbon-fibre reinforced plastic passenger cell combines lightness and strength

Light, strong aluminium module houses powertrain

Battery pack located underfloor lowers the centre of gravity.

The i3's unique vehicle architecture is based on the LifeDrive structure, which combines CFRP passenger cell and aluminium powertrain module.



features such as the Concierge Services information facility and the Intelligent Emergency Call function.

The BMW ConnectedDrive services specifically designed for BMW i focus on navigation and energy management. The Range Assistant is engaged both for route planning and during journeys already under way. If the destination programmed into the navigation system is beyond the car's range, the system suggests switching to ECO PRO or ECO PRO+ mode and calculates a more efficient route.

A dynamic range display supplies drivers with exceptionally precise, up-to-date and reliable information on whether there is sufficient charge to reach their destination and, if so, how much power will remain at the end of the journey. All the factors affecting range are considered in the calculation process, which is carried out on a BMW server and sent to the navigation system via the SIM card installed in the car, where it is presented in the form of a spidergram on the navigation map in the central information display.

Drivers can use the BMW i Remote app to share information with their car at any time, too, using their smartphone. For instance, it enables smartphone access to useful vehicle data for journey planning. If the BMW i3 is hooked up to a charging station or the BMW i Wallbox, the supply of energy can be viewed via smartphone. The air-conditioning and heating function for the high-voltage battery pack can also be activated remotely. In addition, customers can use their smartphone to send destinations to their car's navigation system. The app also shows the car has sufficient power remaining to reach a destination. The car's range limit display

on the smartphone screen replicates that provided by the car's navigation system.

The BMW i3 is also available with an array of other innovative BMW ConnectedDrive driver assistance systems developed specifically to enhance convenience and safety in urban conditions.

The point is that innovation is, of course, not simply doing different things: it is also doing things differently. That's why, in the BMW i3, intelligent connectivity, as is clear, paves the way to maximum driving pleasure in a car whose drive system produces zero local emissions.

BMW has developed remote services specifically for its i range, with accessibility via smartphones and associated devices such as smartwatches.

At the cutting edge

Sheer driving pleasure? Try this for size: supercar looks, 266 kW and 570 N.m on tap, a 0-100 km/h time of 4.4 seconds, a top speed of 250 km/h – and economy of a staggering 2.1 litres/100 km. That's the sizzling i8, which takes new-wave energy systems to extremes. This plug-in hybrid represents the cutting edge of BMW's EfficientDynamics technologies in the shape of a thoroughbred sports car.



SMARTSHIP

Bigger, better – and now, smarter. Innovative amenities, accommodation and communications tech combine in a new-generation cruising ship that's a class above



WELCOME TO THE WORLD'S FIRST SMARTSHIP. More than just a floating hotel, more than just an update on the venerable cruising tradition, *Quantum of the Seas* is the standard-bearer of a new generation of vessels that are re-imagining the idea of a holiday at sea.

Ship seems an almost inadequate description for *Quantum* and her sister vessel *Anthem of the Seas*. First out of the blocks was *Quantum of the Seas*, which undertook her maiden voyage late last year, making the crossing from German shipyard to home port of Cape Liberty Cruise Port in Bayonne, New Jersey in the USA in November 2014. *Anthem of the Seas* is due to follow in the Northern spring of 2015.



FAST FACTS

Registry	Nassau, Bahamas
Shipyard	Meyer Werft, Papenburg, Germany
Gross tonnage	168 666
Length	348 metres
Width	41 metres
Draught	8,5 metres
Cruising speed	22 knots
Guest decks	16
Total decks	18
Guest lifts	16
Bow thrusters	4, each 3 500 kW
Total guests	4 905
Crew	1 500



These new Quantum-class designs are huge, of course: they span 16 decks, encompass 167 800 gross registered tons, carry 4 180 guests at double occupancy and feature 2 090 staterooms. But they are also technologically advanced, incorporating game-changing features and ideas that could conceivably make passengers simply not want to get off.

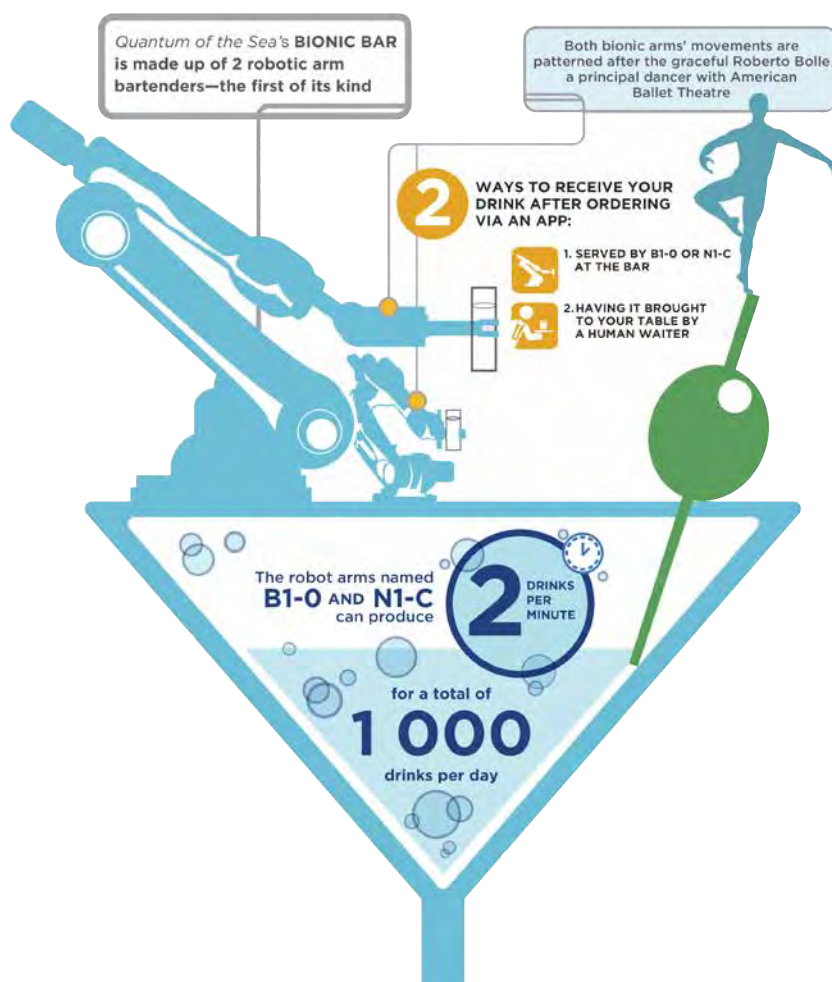
Owners Royal Caribbean operate a fleet of 21 vessels that travel to the Caribbean, Europe, Alaska, South America, the Far East, and Australia and New Zealand. They say the Quantum class of ships will take a dramatic leap forward, introducing more “firsts at sea” such as a skydiving experience, a soaring eyrie more than 100 metres in the air, “transformative venues” including the largest indoor sports and entertainment complex at sea and the cruise line’s largest and most advanced staterooms ever. These new, larger staterooms enable innovation in design, storage and comfort – including the industry’s first virtual balconies. The latter feature means that every stateroom on *Quantum of the Seas* will have a view.

“This new generation of ships gave us an opportunity to make another leap in vessel design. Innovation has always been part of our DNA and we have taken advantage of all that creativity to design Quantum cruising,” says Richard D Fain, chairman and CEO, Royal Caribbean Cruises. “The unique features on Quantum will boggle our guests’ minds, but the real strength of the design is how our people have integrated all these diverse components to create a comfortable and exciting experience.”

Passengers not content with merely lounging in deckchairs all day long and going for occasional landside excursions certainly can’t complain about the options available. For instance, while on board previous Royal Caribbean vessels they were already able to indulge in rock climbing, ice-skating and the FlowRider surf simulator. The Quantum Class takes that several steps further.

Among the seagoing firsts and gee-whiz features are:

- RipCord by iFLY, skydiving in a safe, controlled environment, even for beginners. The sensation of flying takes place inside a seven-metre-tall glass flight chamber, surrounded by a viewing platform. Before taking flight, guests are required to register and participate in a training course and are then outfitted in their flight gear.
- North Star, a glass capsule that soars more than 100 metres in the air for 360-degree views.



Quantum of the SeasSM CONVEYANCE FACTS

The river conveyance is a unique process for ships built at the Meyer Werft Shipyard in Papenburg, Germany. Unconventionally situated inland to avoid impact from storms in the North Seas, Meyer Werft has been sailing ships 32 kilometres down the River Ems to sea since 1795.



WOWband wristbands use RFID technology to provide a range of services: finding your way around the ship and making on-board purchases are accomplished by a simple tap. The band also serves as the room key.

- Superfast wireless connectivity matching what's available ashore.
- The world's first robotic bartenders.
- RFID luggage tags that provide the option of tracking luggage in real time through smartphones and a downloadable app.

Robots drive another entertaining feature on *Quantum of the Seas*. Two70 is home to a playful and agile troupe of six Roboscreens that stage surprise performances during every

QUANTUM OF THE SEAS IS THE **LARGEST SHIP** TO LEAVE MEYER WERFT AND TRAVEL THROUGH THE RIVER EMS AT 168 666 GROSS REGISTERED TONS



There are only a **few centimetres** of clearance on either side of the ship as it travels from the shipyard to the channel

BRIDGES ARE EITHER OPENED OR REMOVED,



AND POWER IS CUT OFF TO POWER LINES AT 3 LOCATIONS CAUSING THEM TO SHRINK AND RISE UP SO THE SHIP CAN PASS WITH AS LITTLE CLEARANCE AS 1,8 M

THOUSANDS OF SPECTATORS

come out to watch the conveyances along the River Ems



THE SHIP PASSES THROUGH



USING 3 GPS DEVICES AND 4 PILOTS TO ENSURE SAFE PASSAGE



THE SHIP MUST MANOEUVRE **BACKWARDS** DOWN THE RIVER IN ORDER TO OPTIMISE CONTROL

This protects the azipods/propellers since the rear of the ship stays in the center of the river when manoeuvring in reverse

In order to have a successful **CONVEYANCE** the following conditions must be met:

wind speed = **20 knots or less**



FULL or new moon



TIDAL BARRIERS must be closed in order to ensure enough depth remains under the ship's hull



2 TUGBOATS EACH WITH 6 700 kW ARE REQUIRED TO GUIDE THE SHIP



THE SHIP MOVES AT APPROXIMATELY **2-3 KNOTS** DOWN RIVER, THE SAME NORMAL WALKING PACE AS A 40-YEAR OLD MAN



CONVEYANCE TAKES **10 HOURS** to sail 32 KILOMETRES down the River Ems, the same amount of time it takes to fly from New York to Athens



The time will vary based on a variety of conditions leaving only an exact window of time for launch onto the River Ems

WHERE THE FUN NEVER SETS

Shipboard activities on *Quantum of the Seas* will keep guests busy until long after the sun has gone down



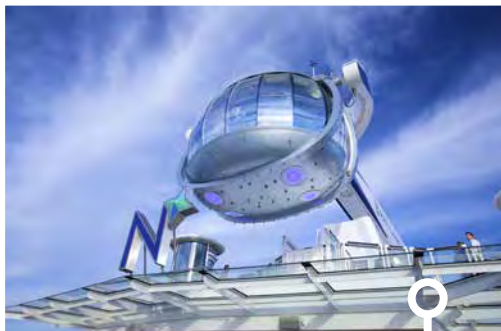
iRipcord, the first skydiving experience at sea, offers the thrill of skydiving without ever departing too far from a firm surface underfoot. This skydiving simulator takes place inside a 7-metre-tall glass flight chamber – so participants can share the experience with spectators.

By day, SeaPlex offers adrenaline junkies their fix in a variety of ways: the first flying trapeze at sea, a circus school that features juggling, and a full-size basketball court that can be converted for use for sports such as soccer, volleyball and badminton. After sunset, it's time to get into the fairground mood with the first-ever bumper cars and roller skating afloat, while those in the party mood will be entertained by sound and lights orchestrated by a hovering DJ booth.



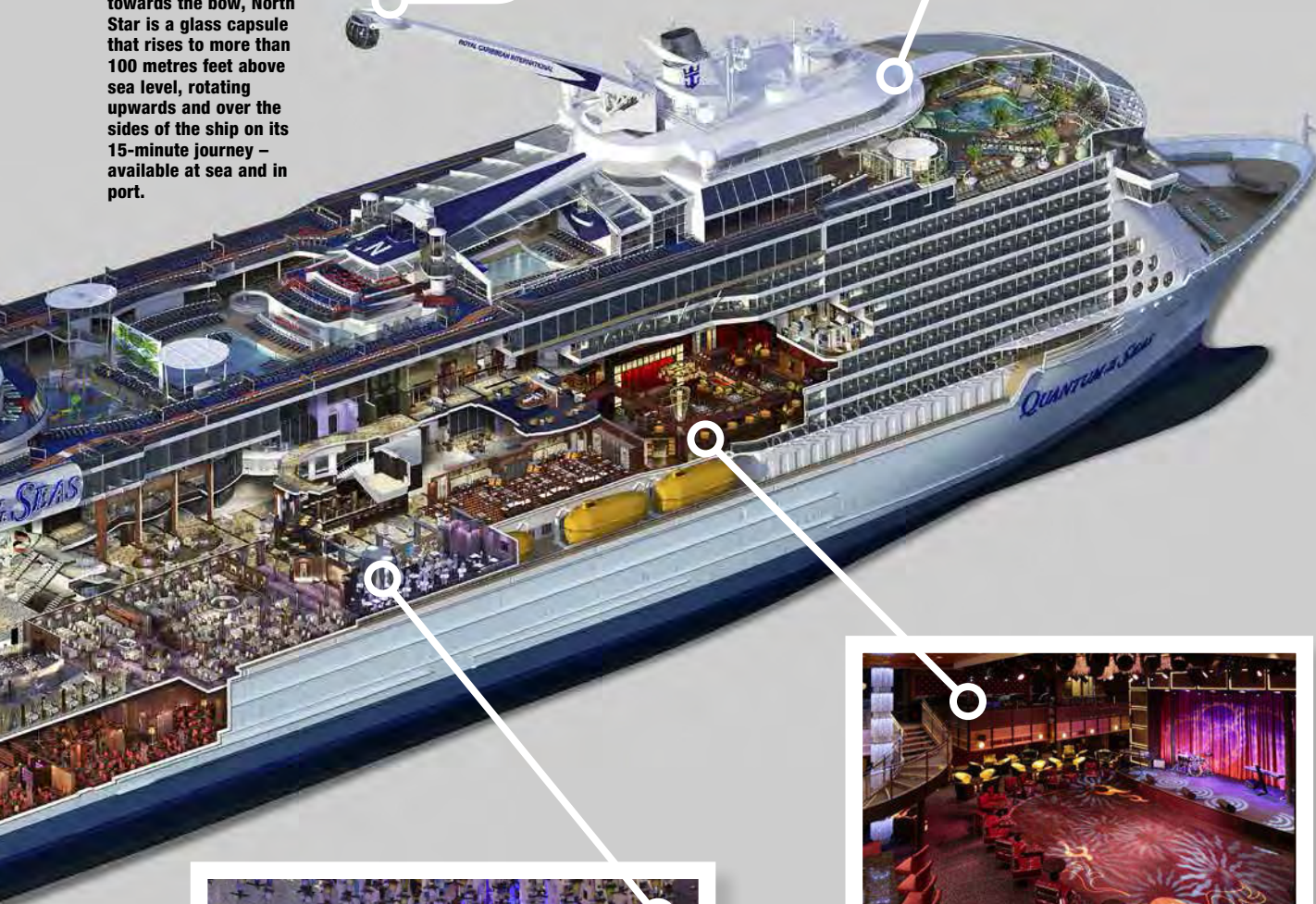
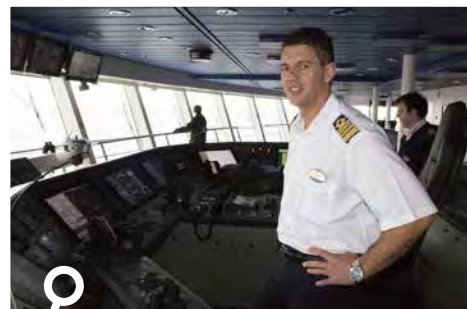
Two70 is home to a troupe of six Roboscreens that stage surprise performances during every cruise, creating scenes while soaring and twisting solo, or together. Top musicians, groups and bands provide a virtual concert experience, projected across Vistarama and all six Roboscreens.





Located on the top deck towards the bow, North Star is a glass capsule that rises to more than 100 metres feet above sea level, rotating upwards and over the sides of the ship on its 15-minute journey – available at sea and in port.

Each crew member receives a personal Microsoft Windows tablet, with a suite of services and apps. It's planned to roll out that programme across Royal Caribbean fleet, amounting to a total of 40 000 tablets.



By day, the two-storey Music Hall hosts activities such as dance classes; by night, it's the ship's showtime hub.



Muddled, stirred, shaken or strained? The brace of robotic bartenders in the Bionic Bar are able to create an almost limitless variety of customisable cocktails.



cruise, creating scenes while soaring and twisting solo, or uniting as one.

Quantum of the Seas will also offer new RFID WOWband wristbands, which require only a simple tap to quickly navigate the ship, make on-board purchases, serve as the room key and more. Royal iQ, available as a downloadable app and provided at freestanding iQ stations around the ship, allows guests to manage details during the cruise, includes a convenient calendar that provides at-a-glance views of their programme, and keep in touch with one another and home via phone and text capabilities.

In addition to this, each crew member on board *Quantum of the Seas* will receive a personal Microsoft Windows tablet, with a suite of services and apps, that is theirs to keep. And as technology upgrades are made across the company's fleet, every shipboard employee in the entire Royal Caribbean International fleet will also receive their own tablet – a total of 40 000 tablets.

Other amenities on board the Quantum class include a Spa and Fitness centre, four pools, four whirlpools, an "Adventure Ocean" youth area, sports court, rock-climbing wall, FlowRider surf simulator, jogging track, outdoor movie screen, art gallery and medical centre.

And, of course, that ultimate shipboard amenity: shopping. The Royal Esplanade and The Via are a parade of premium brands from Cartier to Kiehl's, BVLGARI and Hublot.

"We are excited to be introducing major advancements in ship design and offerings on *Quantum of the Seas* and *Anthem of the Seas*," says Royal Caribbean International president and CEO Adam Goldstein. "The innovative spirit of our brand is alive and well, and with Quantum class, we will deliver more unexpected activities in the most extraordinary spaces. Our guests should prepare to be wowed."



Shipboard luxury includes live shows (top), sumptuous accommodation and fine dining thanks to partnerships with renowned chefs such as Jamie Oliver, Michael Schwartz and Devin Alexander.

THAT'S ENTERTAINMENT

Keeping the passengers entertained shipboard simply won't be a problem, given what the ship's owners describe as "cutting-edge transformative venues".

- **Two70°** – Named for its 270° panoramic sea views through vast, floor-to-ceiling glass walls, this venue can accommodate 540 and spans nearly three decks. Unparalleled technology means every show at Two70° is multi-dimensional and immerses the audience through a combination of live performers, including aerialists, as well as breathtaking video and digital scenery. Highly advanced digital displays, Vistarama and Roboscreens, intertwine with live performers, music and special effects to deliver spectacular, multi-dimensional shows

- **SeaPlex** – Billed the largest indoor active space at sea, it offers all the fun of the fair for all ages. Uniquely flexible, it offers, among other attractions, bumper cars, a circus school with flying trapeze and roller skating. There's even a full-size basketball court.

- **Music Hall** – Live performances, DJs, theme events, billiards and more are offered in this 559-person venue.

- **Royal Theatre** – Seating for 1 300 and facilities that would put many onshore venues to shame.

HOME FROM HOME

The Quantum class features the most spacious and advanced seagoing accommodation ever, introducing rooms that on average are nine per cent bigger than those of the cruise line's Oasis-class ships. New Family-Connected state-rooms deliver more flexibility for families or friends travelling together, with customisable layouts, separate bedrooms and bathrooms. Loft Suites are larger and located across the stern of the ship offering ocean views.

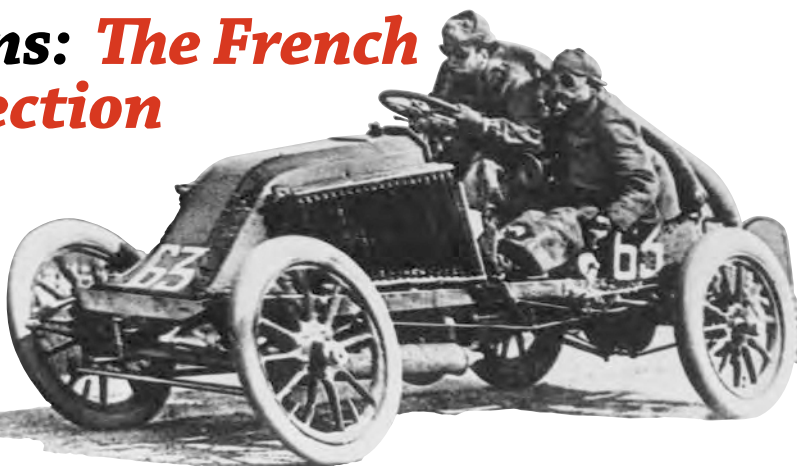
Fine dining is also high on the agenda, with partnerships with celebrated chefs Jamie Oliver, Michael Schwartz and Devin Alexander. Guests have total control of their own culinary journey and can choose from a landscape of 18 distinctive restaurants. Five complimentary, full-service restaurants replace the traditional, common main dining room, in addition to a variety of specialty restaurants.

"*Quantum of the Seas* isn't just changing cruising, it's changing how today's traveller vacations," says company chairman Fain. "It's not just how you travel, it's the experience from start to finish. With Quantum we are empowering our guests to customise every aspect of their journey, providing them with an unprecedented level of freedom and flexibility."

PM

RACING TECHNOLOGY THROUGH THE AGES

Origins: *The French Connection*



Whether the motive was using racing to whip up interest in cars among potential buyers, demonstrating national pride or simply indulging in the spirit of competition, there's no question that France took to the noise, thrills and technology of this new form of sport with passion.

The first officially recognised motor race took place on 22 July 1894: the Paris-Rouen rally, organised by *Le Petit Journal*, a Parisian newspaper. It wasn't long before the pattern of races on public roads took hold, spreading first to the rest of Europe and then the New World. By the turn of the century, American media mogul James Gordon Bennett had founded the Gordon Bennett Cup. The traditional of international colours took hold – Blue for France, Green for Britain, Red for Italy.

The French influence was indisputable, though. The earliest accepted use of the term Grand Prix ("grand prize") appears in relation awards in various categories of the *Circuit du Sud-Ouest* in Pau, France. About this time, the term Grand Épreuve (great trial), applied to a series of top races, also gained currency. This could be regarded as the real origin of an international championship, although not run under overall rules and regulations.

Racing at first was a team affair, though not as we know it today. Cars were crewed by a driver and mechanic onboard until the 1920s. Other aspects that we regard as the norm now – a mass start and a starting grid based on timed qualifying, for instance – were also fairly late developments. By now, races on public roads were giving way to events on dedicated tracks.

And the French domination was certainly not absolute.

A Mors on the startline of Paris-Madrid, 1907.



Marcel Renault pilots his eponymous racer in 1903.

Although France had dominated racing's early years in both overall control and competition, the glory days of French makes such as Bugatti were to be overtaken by the rise of first the Italian giants Alfa Romeo and Maserati and then the Germans, Mercedes-Benz and Auto Union. Motor racing began gripping the world's imagination and events snowballed – up to 18 in 1934 alone. The fairly crude two-man racers of the early days were giving way to hugely sophisticated – and tremendously powerful – single-seater machines with supercharged engines of up to 16 cylinders developing nearly 500 kW.

By the 1930s, with rules in place and technology advancing by leaps and bounds, everything seemed on track for a world championship. But an international struggle of a rather different kind intervened. Yet, barely a year after the end of World War II, Grand Prix racing quietly rebooted. The Federation Internationale de l'Automobile (FIA), based in Paris, devised ground rules for single-seater racing categories – "Formulas" – in world motorsport. Competition would be based largely on engine capacity, the idea being to level the playing field between various engine types.

And then, in 1949, the big announcement: a World Championship for drivers. It would run over the course of a year, taking in Europe's six big Grands Prix and the Indianapolis 500, and would be based on a points system. On 13 May 1950, the flag dropped at the UK's Silverstone circuit. Formula One was well and truly under way.

A TRADITION OF EXCELLENCE



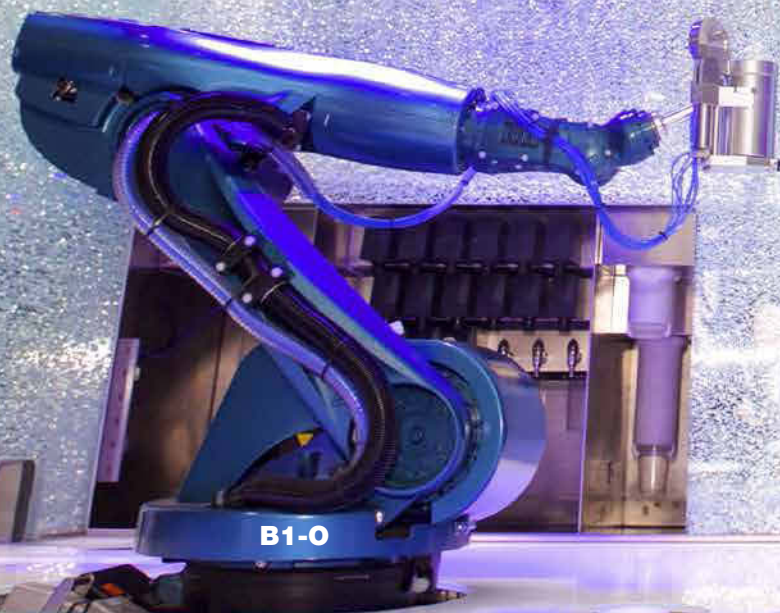
RICHELIEU.CO.ZA [WWW.FACEBOOK.COM/RICHELIEUBRANDY](https://www.facebook.com/RICHELIEUBRANDY)

Not for Sale to Persons Under the Age of 18.

A BEAUTIFUL

273

The number of custom Lamborghinis that could be manufactured in the same amount of time it took to make and test Makr Shahr's B1-O and N1-C.



TWO ROBOTIC ARMS DANCE in a mix between military precision and artistic grace, and at the end of it serve the gin and tonic you need to take it all in. B1-O and N1-C are the bartenders of the Bionic Bar, and they are literally here to serve. Together these appendages of cold metal bring life to the beverages of your choice on board the cruise ship, *Quantum of the Seas*. They can serve any drink you could possibly name or ask them to conjure up, and then shake, stir, muddle or strain it according to taste.

THING

COMPANY:
Makr Shakr

DESIGNED BY:
Carlo Ratti Associati -
Torino, Italy

LOCATION:
On board cruise ship
Quantum of the Seas.

30

SPIRITS and 21
mixers make beverage
options endless.

04

Actions, from
muddling, stirring,
shaking and straining,
make these robotic
bartenders as
versatile as any
human counterpart.

N1-C

As they reach to the rack above them and pour your beverage with just the slightest of pauses in between actions, almost as if to humbly await your approval, their dances stop only when the conveyor belt rests your drink within an arm's reach a mere two minutes later. No tips are necessary here. Their reward is to serve; yours is to be able to watch them perform their magic. **PM**

THE THREAT REPORT

OUR RATIONAL GUIDE TO AN IRRATIONAL
WORLD — FEATURING A HARD LOOK AT
AMERICA'S VULNERABILITIES AND DEFENCES,
A REVEALING VISIT TO THE DARK WEB,
AND A DISPATCH FROM THE FRONT LINES
OF THE NEW COLD WAR.

PART 1

THE LINE IN THE





< The E-3A features the heft of an airliner and the utility of a Swiss Army Knife – and serves as a symbol of NATO's protective mission.

Lately, Russia has been threatening its neighbours almost weekly in what appears to be a Soviet-era show of force. But the rest of the world is not taking Vladimir Putin's imperialist spasms lightly. **POPULAR MECHANICS** was

invited on an official surveillance flight high above Europe as a NATO crew watched for his next move.

> BY JOE PAPPALARDO

SKY

FIGCLOSE my eyes and relax into the drone of the engines and the heavy rush of air, I might almost forget that I'm in a military aeroplane. The NATO E-3A is 47 metres long and built on the same frame as a Boeing 707 airliner, so in contrast to the fighter jets looping through the sky not far away, it is not designed to make any sudden moves. The E-3A is a whale floating along at 10 600 metres and I am buckled into its belly.

There are few windows. I am sitting at a console with square, lit switches – one of a bank of consoles lined up three across against the starboard side of the plane. Men in pressed NATO uniforms with patches from their home countries scrutinise every blip, swirl and ping emanating from the equipment. The aesthetic is vintage 1970s Air Force – all exposed wires and monochromatic colours and seats bolted to the floor, a triumph of utilitarianism. A yellow-and-black-striped handle juts from a bulkhead, a white grate on the floor below. A sign reads: BAIL OUT CHUTE, AIR USE ONLY. It's defunct, but no one lingers on that spot.

The sun is still low after our 7:15 am departure. I'm here because I was issued a rare invitation to shadow a NATO crew on a 7½ hour surveillance mission over Poland. The E-3A is also known as an Airborne Warning and Control System (AWACS) aircraft, and this flight is part of NATO's recently rejuvenated effort to monitor and discourage Russia's military activities, and to reassure the Poles that its allies will be there to quell any aggressive moves by Vladimir Putin should the Russian leader continue to try to rewind Europe back to the late 1970s.

Relations in this part of the world have

THE THREAT REPORT



been tense since the northern spring last year, when Russia annexed Crimea and helped prop up separatists in eastern Ukraine. Older people in Eastern Europe have seen such developments before – a superpower suddenly snatching away some or all of a sovereign nation – and they often end in violent repression or war, or both. Poland, whose borders touch both Russia and Ukraine, has been overrun by hostile neighbours more times than people there care to count, and many Poles told me they feel distrustful of Putin's sudden latter-day Stalin imitation.

The tension from the shooting on the ground – Russian-backed separatists and soldiers exchanging fire with Ukrainian troops – extends up to this cabin. Just before our mid-September flight, Russian fighter-bombers violated Swedish airspace, buzzed a Canadian military ship in the Black Sea, and encroached on Alaskan airspace. In the months after, a NATO radar team would detect and track a Russian intelligence-collection aircraft that would enter NATO airspace over Estonia. In three days in late October, NATO would detect and monitor four groups of Russian aircraft conducting “a major air exercise” in international airspace, according to the alliance. By late November, the Russians would be on pace in 2014 to more than triple the previous year's military aircraft exercises.

“What bothers me most is the offensive nature of what they are doing,” says Lieutenant-Colonel Ireneusz “Palm” Nowak, the base commander at Lask Air Base in Poland, says. “They are seeking new influence, new land. The activity we observe is of a very aggressive nature.”

Well, then. This should be an interesting ride.



The crew – from left, pilot Olivier Gilson of Belgium, flight engineer Amodio Iaderosa of Italy, and aircraft commander Massimo Maieron of Italy – all speak a technology-heavy version of English on the flight.

THE CREW MEMBERS are wearing headsets to block out the constant whoosh of air outside the fuselage, and so they can pass information around the plane and to other aircraft. I put a headset on and am immediately plugged in to a half-dozen technical conversations erupting at once – a drumbeat of acronyms, jargon and co-ordinates spoken in English, but that sounds like another language altogether. E-3A crews pride themselves on being able to tease out the information they need from this blizzard of chatter.

Some of the crew are conducting surveillance operations on the consoles. A nine-metre-diameter radar sits atop the E-3A, scanning the sky above Poland and over into a slice above Ukraine, watching for Russian aerial incursions such

as the recent one in Sweden. The radar antenna, spinning inside a disc-shaped housing mounted on the plane's back, can change the strength and shape of its pulses to spot low-flying aircraft at more than 350 kilometres, or high fliers at twice that range. At other stations on the plane, NATO personnel monitor radio transmissions and radar waves that can identify targets for warplane pilots and ground commanders if a shooting war breaks out below.

On one headset Captain Matteo Tani of the Italian air force directs two fully armed Polish air force F-16s. His job is to ensure, from 140 kilometres away, that the fighter jets stay in their designated airspace, away from civilian planes passing overhead.

“Turn left, descend to flight level 2-1-0, heading 1-3-0,” Tani says in thickly accented English. A voice with an equally heavy accent, this one of the Polish pilot, acknowledges the guidance. The Poles spend an hour performing mock interceptions, taking turns playing the foe, which in this scenario is a Russian MiG-29. The radio crackles with F-16 pilots reporting details about the mock enemy's weap-

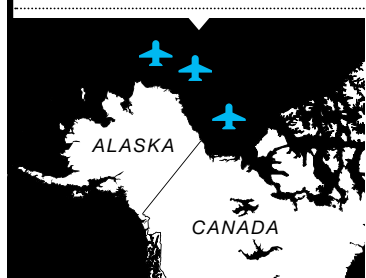


A SEASON OF HOSTILITY

Russia's military encroached on or entered NATO territory 20 times during 67 unusually hectic days towards the end of last year. Together with incidents earlier in 2014, they "add up to a highly disturbing picture of violations of national airspace ... and other dangerous actions happening on a regular basis," a NATO report from November said.



Not pictured:
Russian strategic bombers in the Labrador Sea near Canada practised cruise missile strikes on the US.



TYPE OF INCIDENT

- Air
- Maritime
- Ground

RISK LEVEL, AS RANKED AND DEFINED BY NATO

- High: Elevated risk of casualties or military confrontation between Russia and the West.
- Serious: Aggressive or unusually provocative encounters.
- Near-routine: Not unusual, but the greater frequency is worrisome.

THE AUTHOR'S FLIGHT: SEPTEMBER 13, 2014

Reported incidents between 1 September and 6 November 2014; Source: NATO

ons. "The Poles like to get creative," says First Lieutenant Bram Wieser, of the Netherlands from his AWACS console.

Sitting at an unused E-3A console, I scroll the tactical screen to examine Kaliningrad, the nearest Russian territory on our path. The isolated spit of land, home to Putin's Baltic Fleet, is sandwiched between Poland and Lithuania and contains Russia's only ice-free European port. The air looks empty of military aircraft, but Russian bases are marked with red icons, the designation for hostile. The crew "sanitised" the images on this console before I sat down – this is a real, full-on strategic NATO military operation, not a public-relations flight – so the multicolour webs that represent the radar emissions from Kaliningrad don't appear. But I know they're out there; I've glimpsed sheets marked "NATO – Secret" that display the locations and ranges of Russia's Kaliningrad radar sites.

Military surveillance, after all, goes both ways. I ask Wieser if Russian radar and emissions specialists are scrutinising us as well. "No doubt about it," he says with a tight grin. "They are playing the same game as we are."

This show of resolve is at least partly political theatre. Without the contributions of the United States – itself looking at tightening defence budgets and embroiled in several global crises – there is no real deterrence in Europe. NATO owns only 17 AWACS aircraft;

fighters, aerial refuelling tankers, and transport airplanes must be begged and borrowed from member countries. And there is not a lot of metal to go around.

A scant handful of NATO partners, the backbone of the deterrent effort, have defence budgets of more than two per cent of their gross domestic product. Economic ties to Russia and an abiding mistrust of US foreign policy sap many allied nations' political willpower to stand up to Putin. And for all the talk of bolstering the presence of NATO in Eastern Europe, the vast majority of the equipment stationed there is being used to conduct unarmed training missions.

Back on the screen, the F-16 icons wheel and dart in a mock dogfight. One pilot locks his weapons radar on his foe; a golden dotted line appears between the icons of the two aircraft. It's an oddly clinical view of an encounter that could, if this were real, represent the start of a new world war.

O

UR FLIGHT took off a few hours ago from Ørland Air Station, a small NATO base near the town of Brekstad, Norway, and followed a route that calls to mind some of the flashpoints of modern European history.

Norway endured a Nazi invasion in 1940, and these days the Norwegians fret about Russia's designs on the resource-rich Arctic. The AWACS has permission to fly over Sweden, but the crew conducted no radar surveillance. Instead they primed the equipment as we headed over the neutral country while those without tasks ate sandwiches or heated food in the galley ovens.

Once we reach Poland, the E-3A becomes "on station". At one console in the rear, Staff Sergeant Nick Grafton sits before a trio of screens, each displaying pulsing graphics, oscilloscope waves, and jagged, spiked circles. Grafton is a radar tech trained to divine meaning from the scribbles and patterns.

Most of what he does is classified, but too hard to explain anyway. "I've been working with this system for about 10 years," Grafton says. "And there are still things it does that I've never seen before." He teaches me a couple of tricks, though. The screen to the far left, with a circular display, measures the strength of inbound signals affecting the circular radar. Each spike represents a power source, and Grafton's job – one of them – is to determine if these surges will affect the radar's main antenna. Jagged spikes from a specific direction could mean the E-3A is being intentionally jammed. Fortunately, the plane is equipped to overpower most interference, he says.

Each crew station solves a puzzle piece of what's going on. The radar operators can spot aircraft flying low to the ground. The passive-detection equipment can help identify that it's a warplane by the signals it's emitting, or by what it's failing to transmit. (Civilian airliners "squawk" over certain frequencies, making them easy to identify.) The radar operator can ask the pilot to level out the airplane, decreasing the ground clutter from the radar returns by changing the angle of the radiating waves, thereby gaining a better image. It's team sleuth work.

The E-3A can also spot vessels on the water. A Toughbook laptop is set up near one console bank, close to where the surveillance section sits. Its screen shows



With the E-3A back on the ground in Norway, First Lieutenant Bram Wieser, foreground, and Master Sergeant Angel Garcia lead the way to the debriefing meeting that wraps up every mission.

commercially available ship-tracking data (using the automatic identification system, or AIS). If a radar return doesn't match the AIS data, the aircraft may have uncovered a military ship sneaking around, or a smuggler on a run. If the emissions experts and radar techs see abnormally high activity, there's a good chance it's a military vessel. The information is sent to NATO bases in Germany for analysis.

It's not as easy as looking at an infrared video or a satellite feed, but this AWACS has more than 300 000 square kilometres in its field of view, so it has to have different sets of eyes that work in complex ways. Data streams in from across the electromagnetic spectrum. "We have the God's-eye view," says Sergeant John Brewer, a US weapons-section operator on board.

Fighter pilots on the ground in Poland stand on alert – the official phrase is quick reaction alert, or QRA – ready to dash to warplanes if they or an AWACS detect Russian aircraft. Even when the Russians keep to their airspace, the Poles scramble fighters to shadow them when they near the border, just so they know they're being watched.

At Poland's Lask base, where the QRA flights originate, Nowak tells me the Russian aircraft cruise the Polish border on what professionals call *recce missions* – reconnaissance to probe the readiness and defences of the NATO crews. "They test the time of reactions, radio freqs [frequencies], how our jets move," he says. "Most of the time we accompany them along the Polish border, then pass them off to another nation's QRA."

The Poles have recruited the United States and other allies to boost their air force. But Nowak knows the Poles would be outnumbered and outgunned if they faced Russia in combat. Most of their air force still uses Soviet-era aircraft that would fare poorly against new Russian warplanes and

LIEUTENANT-COLONEL NOWAK KNOWS THE POLES WOULD BE OUT-GUNNED IF THEY FACED RUSSIA IN COMBAT. "WE HAVE TO CATCH UP WITH THEM. THERE'S NO OTHER WAY."

THE TECHNOLOGY OF TERRORISM

Trying to protect a country such as the USA from violent extremists requires creativity, hard work and technological expertise. They build a new bomb, the US tries to keep it off planes. They hack the cyber infrastructure, the US locks them out. Here a few of the most recent developments on both sides.

> BY PW SINGER, JEFFREY LIN, JOE PAPPALARDO, KELSEY D ATHERTON AND JACQUELINE DETWILER

mobile surface-to-air missiles. "We see Russian equipment getting better and better, and we have to catch up with them," he says. "There's no other way."

The crew in the AWACS cockpit is wrapping up the mission. Down on Earth, the magnificent desolation of Norway stretches to the horizon. Lichen grows on every rock on the coast, and the ground is a green-brown carpet broken by humps of smooth, weathered mountains. As the E-3A begins its final approach back to the NATO base, the aircraft commander, Major Massimo Maieron, keeps an eye on the man to his left. Olivier Gilson, a Belgian first lieutenant, is in training, and he's the guy landing the plane.

Soon the alien terrain gives way to civilisation: a lighthouse, a farm, a road, then the glowing crosses marking the Ørland runway. The E-3A barely jostles as Gilson eases it down. This was a relatively short trip – some missions extend, courtesy of aerial refuelling, for more than 12 hours. Maieron's longest mission was 16 hours circling over Afghanistan.

From the sky the Afghanistan mission was largely the same, he says. It was on the ground that things felt different. "When we land here," Maieron says, "we don't have to wear flak jackets." He and Gilson, after shutting down the aircraft and discussing the landing, are the last crew off. They step down on the tarmac, flight bags in hand. They're both eager to shed their flightsuits, but the debrief awaits, and the rest of the crew is already inside. Maieron and Gilson stride towards the looming E3-A hangar, two small green figures before white doors the size of Jumbotron screens. Eight hours after taking off, the pair walk into the towering crack between the hangar doors and vanish inside. Soon, another crew will take off for the same mission, and another crew after that, and then another, until nobody needs to watch Vladimir Putin and his army anymore.



IN THE AIR

THE LAND-BASED AEROPLANE BOMB

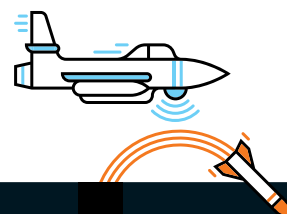
USED BY: **THEM**

WAR AND REVOLUTION in the Middle East have opened military arsenals in Libya and Iraq to extremists and black markets. This is not good, no matter what the bad guys buy, but it's especially dangerous if terrorists get their hands on shoulder-fired anti-aircraft missiles. Though many international flights avoid taking paths over known conflict areas where they might be at risk even at more than 10 000 metres, shoulder-fired missiles are portable and could be smuggled near enough to an international airport to do serious damage to planes during take-off and landing. Missiles such as the heat-seeking Russian Igla, which are already in Iraq, can fire up to 3 300 metres in the air along a three-kilometre-long corridor, making most airports viable targets.

THE PLANE-MOUNTED MISSILE BLINDER

USED BY: **US**

SYSTEMS THAT CAN PROTECT AEROPLANES from missiles do exist. Some US military transport planes are already equipped with Directional Infrared Countermeasures (DIRCM) pods that can blind incoming missiles. A 250-kg pod mounted under the fuselage uses a laser to beam infrared energy into the missile's heat-seeker, overwhelming the sensor and causing the missile to lose its target. In the past decade two defence manufacturers, BAE Systems and Northrop Grumman, made prototypes for civilian airliners, but they were too expensive to employ widely. The only way the airlines will ever consider them a good return on investment is if shooting down civilian airliners becomes a regular threat.



THE THREAT REPORT

COULD A TERRORIST ATTACK THE SUPERBOWL? "I don't think [ISIS] would, because it wouldn't be best for them in the long run. Sometimes the insider threat trumps that. Two years ago [a 9/11 truther] got in and got onstage at the press conference after the game. He was able to gain access just by saying he was late for his shift." – JAMES A MCGEE, FOUNDER OF PHASE LINE GREEN SECURITY CONSULTANTS

IN THE AIR



THE OLD EXPLODING CLOTHES TRICK

USED BY: **US + THEM**

THIS IS HOW IT GOES:

Terrorists try to smuggle liquid explosives on to planes in bottles, so the Transportation Security Administration limits travellers to 100 millilitres of liquid per person, an insufficient quantity to bring down a plane. In response, terrorists try to find a new smuggling method. Anonymous senior US security officials recently alerted reporters that some groups have researched dipping clothes in liquid explosives, such as acetone peroxide, that are not detectable by dogs or any routine TSA security scan, letting them dry, and wearing them on flights. So, hey, that's not great. But there is some good news: First, only a small quantity of explosives can be infused into clothing. That's enough to hurt people, but not enough to bring down an aeroplane. Second, a Montreal-based company, Genia Photonics, is testing a laser-based molecular scanner that could pick up chemical traces without requiring passengers to strip in the TSA line.



A few questions for former US Department of Homeland Security Secretary **JANET NAPOLITANO**

PM: In your farewell speech to the DHS, you warned about

cyberattacks. We tend to spend most of our time worrying about bombs and kidnappings. Is the US leaving the back door unprotected? **Napolitano:** I think, as a country, we have a long way to go in terms of protection against cyberattack, in part because the whole field changes so rapidly. But this was a constant message we were giving to



AT SEA

A GARRISON OF ROBOT FISH

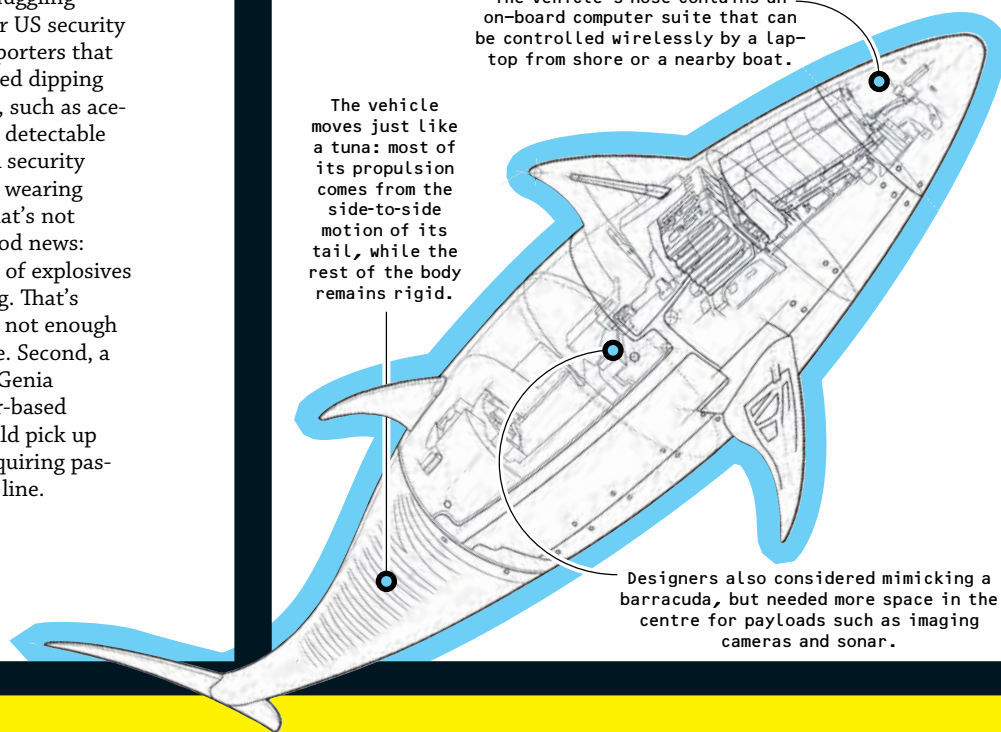
USED BY: **US**

TO PATCH THE HOLES in notoriously leaky port defences, Boston Engineering Corporation and the US Department of Homeland Security have developed an autonomous underwater inspection device based on... the tuna. It is more agile than other underwater robots and can search for mines or improvised explosive devices in flooded ships and other areas that are too dangerous for human divers. Here's how it works.

The vehicle's nose contains an on-board computer suite that can be controlled wirelessly by a laptop from shore or a nearby boat.

The vehicle moves just like a tuna: most of its propulsion comes from the side-to-side motion of its tail, while the rest of the body remains rigid.

Designers also considered mimicking a barracuda, but needed more space in the centre for payloads such as imaging cameras and sonar.



Congress and industry and the public. If we were asked, What are the areas of greatest vulnerability? I think we would all put cyber right at the top of the list.

– **Are groups like ISIS capable of these kinds of attacks, or are you more concerned about homegrown groups?** I don't want to tie it specifically

to ISIS and al-Qaeda, but I will say that the attacks come from a variety of sources. Everything from individual hackers, which I might not even characterise as an attack – sometimes people experiment to see how far they can get into a system – to attacks that we can actually attribute to a nation-state. And everything in between. Does that include groups that have a

ARE EMBASSIES SAFE? “Ultimately, protection of embassies is the responsibility of the host country, but the US does take an active posture to protect its installations. Considerable security forces, reinforced perimeters, secure locations within embassies, and military and State Department reinforcements are all part of a system to deter, stop, or at least slow down attacks by all but a large, well-armed, and well-trained paramilitary force.” – JAMES JEFFREY, THE WASHINGTON INSTITUTE; FORMER US AMBASSADOR TO IRAQ

THE TRANSFORMING CARGO CONTAINER

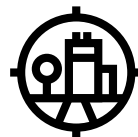
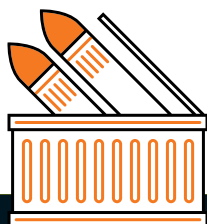
USED BY: **THEM**

YOU CAN SEE THE SCENE from a military thriller: a cargo ship is sailing along with a normal container on its deck. Suddenly the container tilts upright, the lid flips open, and out pops a cruise missile that blasts into a nearby port city, causing panic and destruction. It's all very *Homeland*. Except it's real. In 2012, Russian defence company Concern Morinformsystem-Agat JSC began testing this system as a last-resort defensive weapon, a martial ace in the hole that could remain hidden during a bombing campaign by a foreign power and emerge to strike back. CGI marketing videos show the missile being used to repel aircraft carriers, but if it fell into the wrong hands, in the same way a certain Russian-made anti-aircraft missile that allegedly shot down Malaysia Airlines Flight 17 last year did, we could be in trouble.

THE IMITATION SMUGGLING SUB

USED BY: **US**

NARCO SUBS, CLANDESTINE underwater vessels that South American cartels often use to transport drugs between countries, are one way terrorists could smuggle in weapons. These vessels skim along just beneath the waves and are relatively hidden from radar. Some remote sensing technologies, such as airborne radar, might find them, but these technologies need to be consistently and thoroughly tested to pull it off. This is why the US Department of Homeland Security (DHS) built its own homemade submersible, a 14-metre, three- to four-person watercraft called PLUTO, in 2008. Its handlers at Eglin Air Force Base in Florida, have used the sub to test such technologies as P3 radar systems in Navy aircraft and Customs and Border Protection's Dash 8 planes. PLUTO is still making test runs today, but the government is keeping quiet about the latest detection techniques.



ON LAND

ETSY FOR TERRORISTS

USED BY: **THEM**

THE AVAILABILITY OF Internet instructions and the proliferation of small but capable means of production are a godsend to inventors and makers. This, unfortunately, includes inventors and makers with nefarious intentions. A guy with a grudge and access to a biology lab could, theoretically, print smallpox DNA from a recipe for the smallpox genome that's available online, and use suitcase-size microreactors – machines that speed up chemical production – to create enough toxins to spread in a public space. And thanks to new Internet databases, bioterrorists can find quick hacks to maximise production and lethality. If they'd rather launch a chemical attack, there are now better microscopes and computational software that can be used to build tens of thousands of new compounds.

nefarious purpose? The answer, I would say, is yes.

Are there specific steps we could be taking to be more prepared?

I think a lot of this has been left in the hands of the private sector, to increase their investment in – and the care taken with – cyber-attack prevention. I think many companies are very, very good,

but many, because there's not an immediate return on investment for this sort of thing, are more vulnerable. In an interconnected world, a vulnerability someplace can lead to cascading implications.

In some respects, it seems private industry would be more agile than the government at that kind of thing.

Oh yes. I think that that can happen. It's easy for government to kind of retreat into a, how do I want to say, relaxed pace.

Now that you're the president of the University of California system, do you ever miss the excitement of working in national security?

I miss having my own plane. That was good. You know, I

enjoyed my time as the secretary. It was a privilege to serve there, but I don't have time to reminisce too much.

Flying commercial is tough. Does the TSA make you take your shoes off?

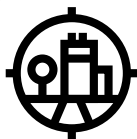
No, I have PreCheck. Which you should get, too, if you haven't already. It's great. Saves a ton of time.

THE THREAT REPORT

WHAT ARE WE REALLY AFRAID OF? Man-made disasters we're most worried will occur in the next 25 years, according to the Chapman University Survey on American Fears.



ON LAND



THE PHYSICAL ONLINE ATTACK

USED BY: **US + THEM**

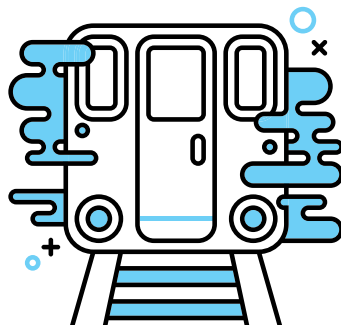
IN 2009, A WORM CALLED Stuxnet, developed by Israel and the US, devastated an Iranian nuclear laboratory by increasing the pressure in its centrifuges until they spun out of control. The good guys used a computer virus to cause kinetic, physical effects on actual electrical equipment. This is an enormous achievement. But the US has vulnerabilities of its own in this respect. Its power grid is increasingly linked to networks of computer-controlled equipment – the type that runs smart-meter technology, for example – that are open to hacking. This could allow the country's enemies to destroy machinery such as substation current transformers and power-plant turbines. One way such an attack might play out was the 2007 Aurora Generator Test by the DHS at the Idaho National Laboratory. Hired hackers caused the circuit breakers of one particular generator to rapidly open and close out of phase with the rest of the grid, causing the machinery to explode.

THE NEW SUBWAY CANARIES

USED BY: **US**

IN 1995, JAPANESE CULT Aum Shinrikyo attacked the Tokyo subway, releasing sarin gas and killing 13 people. The story is a grim reminder of transit-system vulnerability, but there is hope for future safety: US homeland security has developed two programmes to detect these kinds of agents underground. The first, the Autonomous Rapid Facility Chemical Agent Monitor, uses an ion-mobility spectrometer to search for trace chemical vapours such as sarin.

The second, Detect to Protect (D2P), finds biological material in the air, then does lab-quality analysis in half an hour to determine whether it has found an attack or something less sinister. D2P has already been tested with an inert agent in Boston's transit system and could be deployed this year.



PREDICTIVE BOMB DETECTION

USED BY: **US**

IF AUTHORITIES HAD known a week in advance about the homemade bombs that were detonated at the 2013 Boston Marathon, all we would remember about the race is the photo of the winner in the next day's newspaper. Predicting where and when someone will use explosives sounds impossible, but bomb making does have telltale signs, and people working on a project called Explosive Material Production Hidden Agile Search and Intelligence System, or EMPHASIS, in Sweden know just where to look for them: the sewers. EMPHASIS is a network of underground electrochemical sensors that can locate explosives by finding the by-products they form in water, such as nitrotoluenes and nitromethane. When high concentrations of bomb ingredients are detected, authorities can use them to begin a search, hopefully locating the makers and stopping their plot before they have a chance to carry it out.



ISIS is better at advertising than advertisers
A bold claim by a creative executive at a major advertising agency.

ADVERTISERS AND BRANDS usually get blamed for screwing up the Internet. We're seen as the ones who brought you banner ads, YouTube commercials, and sponsored content. We're the puppet masters, manipulating your emotions and fuelling the engine of consumption. There's some truth to that, but

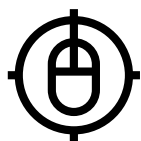
in the realm of online videos that passionately engage young people and induce them to form communities, we're amateurs compared with ISIS.

The now-notorious execution videos are bad enough. They are shrewdly produced. Slick. The work of experts. But they're not the ones we should be

most uneasy about. The really terrifying ones feature smiling young people, shaky camera work, and an authentic feel. They target our kids.

Thousands of Westerners have joined ISIS over the past several months, something other jihadi organisations haven't been able to do on this

SHOULD I STORE MY INFORMATION IN THE CLOUD? “Think of it like using the safety deposit box at the bank. On one hand, you are putting your valuables in a place where lots of other folks store important things, so it’s a prime target. On the other hand, the company operating it is not only super-incentivised to protect your goods, it’s also likely to have better expertise at it than anyone else does.” – **PW SINGER**, STRATEGIST AND SENIOR FELLOW, NEW AMERICA FOUNDATION



IN THE CLOUD



THE DOX

USED BY: **THEM**

THREATENING PUBLIC figures at their homes is not new, but doxxing, a harassment technique that exposes private information about individuals – sometimes including details such as the name of a day care that a target’s child attends – adds a level of anonymity that is attractive to evildoers. For a long time the technique was used mostly by activist hackers against their chosen targets. For example, following the shooting of Michael Brown in Ferguson, Missouri, this past August, members of Anonymous released the name, address, and Social Security number of the local county chief of police. In October a game designer fled her home when hackers threatened her and her husband following the publication of her address. The same tactic could be used to target government leaders, creating a state of intimidation.

THE SPACE BOMB

USED BY: **THEM**

IF TERRORISTS TOOK OUT our GPS, we’d have worse problems than not being able to find that new restaurant on the edge of town. GPS is also used to guide food-delivery convoys, medical-delivery planes, and weapons. And it wouldn’t be too hard to knock it out at the source. Every country is directly beneath space, which is where all the satellites are. Send a nuke up there, and bam, no GPS.

Most countries wouldn’t do this; the blast would not only destroy all the low Earth satellites in a wide area, its electromagnetic pulse waves (remember that device that cut the power to Las Vegas in *Ocean’s Eleven*?) could fry electronics on the ground, including those of the attacking nation. However, a rogue state with minimal reliance on satellite technology could decide that the collateral damage from eliminating enemy satellites is a price worth paying. Does that sound like anybody we know? North Korea, maybe?

UNBREAKABLE WI-FI

USED BY: **US**

WHEN DISASTER STRIKES, be it an earthquake, industrial accident, or terror attack, cell networks are overwhelmed by the sudden surge in traffic. Many people experienced this on 9/11, when it was near impossible to reach anyone in the New York City area. For first responders, this can add to the confusion of the critical first few hours.

WideBridge, a solution created by Elbit Systems that began testing in September, provides a fail-safe system of protocols built into existing cell networks that allows firefighters, police, the military and medical personnel access via cellphones and push-to-talk devices in case of emergency. Responders can talk to each other and can also send information into protected servers, where operators are able to filter and pass along information to co-ordinate relief efforts. Additional tests are scheduled for early this year.

scale. ISIS has done it by understanding and deploying modern digital marketing as well as the best digital creators in the world. Michelle Phan and Machinima have nothing on these guys.

Watch the recruiting video featuring Canadian Andre Poulin. He sits in front of a still camera and opens up, unscripted and

vlog style, about his reasons for joining ISIS. He hits all the high points: he’s just like you, he’s not a social misfit, he understands your life, and he’s found belonging. The video uses the same cultural references and production values that its intended audience expects and desires. After the vlog concludes, Poulin

runs through a field towards battle accompanied by a narration recounting the glory of his final moments. It’s not much different from the voice-overs in thousands of first-person-shooter play-through videos. Poulin’s death doesn’t look any more final than what happens in *Modern Warfare*. To the target audience, Poulin

went out in a blaze of glory. Here’s a guy who showed them, and look at all the attention he’s got for it.

Forty-five years after the birth of the Internet, it has come to this: the savviest use of digital technology comes from those who would wipe its inventors off the face of the Earth.



THIS MAN WILL SAVE YOU FROM THE EVILS OF THE INTERNET

A gang of Russian hackers was caught last year amassing the largest cache of stolen user names and passwords ever discovered – 1,2 billion in all. Alex Holden, a Ukrainian immigrant to the US, found them. And he knows how to do it again.

> BY CHRISTOPHER SOLOMON

THE MAN'S DEEP VOICE BOOMS from inside his office, his accent thick and Ukrainian and a little menacing. "I want to show you the black market," he says. He is big – over 1,8 metres tall, round in a sturdy way, goatee trimmed short. He strides around his desk, his feet and belly leading the way. He wears shiny black shoes, black pants, a black pinstriped suit jacket.

His name is Alex Holden, although that's not the surname he was born with. The room is in an office park in the grassy suburbs of Milwaukee in Wisconsin, across the hall from a meat broker that sells beef to school-lunch programmes. Hold Security, the name of Holden's firm, is

spelled out on the door, slightly crooked, in those reflective letters people stick on their mailboxes. There is no receptionist, almost nothing on the walls. The employee lounge is an unadorned brown sofa from a friend's attic. In one of the few occupied offices, a young analyst named Olga stands in the dark, staring silently at a screen.

Holden settles into a tall black swivel chair, his eyes scanning one of the four monitors lined up on his massive desk. He types, his thick fingers pressing the keys with surprising speed and grace. Images start to appear on his screen. Assault rifles for sale. Counterfeit euros and dollars. Heroin, arranged like a glossy-food-magazine photo of crumbled Parmigiano cheese. Holden types, clicks. Here is Justin Bieber's home address in Calabasas, California. Here's the address, email, and Social Security number for outgoing United States attorney general Eric Holder. All of this in the span of 5 minutes.

Last summer Holden and his firm landed on the front page of newspapers across the USA when Hold Security found that Russian hackers had amassed the largest trove of stolen online credentials ever discovered. There were 542 million email addresses and 1,2 billion

unique records – email-and-password combinations – in all. Many of the passwords had been decrypted, making them ready for sale on the black market. When I called him a few weeks ago asking to talk with him, he said, “I’m pretty sure that, after you come visit, you will change your passwords.”

Hold Security employs just 16 people. One victim of last year’s mass hack, JPMorgan Chase, spends around R3 billion a year to defend its digital fences, and yet the Russian criminals had been rooting around inside the investment bank’s site for months, hacking, digging, stealing. Holden and his team found them.

“The Internet is a bad place,” he says. “We are playing an interesting game of defence here.” Despite the accent and the heft, Holden himself is actually not menacing at all. He once wanted to be a history teacher and can be windy as a lecturer. He also likes to drop quick, unexpected jokes.

Holden tells me to take a chair. He tilts a big monitor towards me so I can get a better view and gets back to work. The only sounds in the room are the clack of the keyboard and the soft scrape of the mouse on the desk.

As he types, his posture stiffens slightly, and his smile evaporates.

“GOOD MORNING, HUSBAND!” a small Asian waitress chirps to Holden as he walks into Maxfield’s Pancake House, where he’s a regular. Holden, who is divorced, grins big. He only glances at the menu and orders his usual: feta-gyro omelette, no toast, side of cottage cheese. “Atkins,” he says in his *Hunt for Red October* accent.

He talks with enthusiasm about his firm, just two years old and very busy. Being Ukrainian helps, he says – he advertises in Milwaukee’s free Russian-language weekly for people he can train as analysts. This makes Hold Security uniquely suited to focus on the countries of the former Soviet Union, where much financial cybercrime originates. “We’re trying to play where we’re good,” he says, ploughing through his omelette.

There are routine computer attacks, such as spam and basic kinds of malware, that most security systems will catch or stop. Then there are the kinds of cybercrimes



Holden says that, instead of short-term fixes, he believes in working towards hacker extinction.

that only people like Alex Holden can find in places that most of us have no idea how to even gain access to. He functions with unusual success in a world of endless shadows, unknown people in unknown places committing sophisticated crimes no one can see, never even having to leave their homes. And that’s hard. How is Holden able to flourish in a world where corporations and governments are foundering?

When he was a student at the University of Wisconsin-Milwaukee in 1993, Holden talked his way into a programming job by telling a professor that he knew the Visual Basic computer language (he didn’t), then bought a book and taught himself. In the years that followed, most people used the Internet to find information, shop, email friends. Holden, who found the computer and the worlds it contained to be intuitive and compelling, began to explore the tissue that held it together. He never earned his degree, but he did get a job at Robert W Baird & Co., a global financial-services company in Milwaukee that manages more than R1,1 trillion in assets. When he was just 27, Holden became its chief information security officer.

In 2013, he was working at a small security company called Cyopsis that split in two, and Holden wound up with his own firm in 400 square metres of the suburban office park. Hold’s primary service is “auditing and penetration testing”, he says, which means his team identifies potential weaknesses in clients’ networks that allow thefts while also skulking around online to determine whether their information has been stolen. Sometimes Hold Security tracks the hackers themselves.

Online, Holden is always calculating “when to push, when to let people go” – when to press a hacker for information and when to simply sit back and see where the hacker leads him. There is a psychology to his work, but he is hardly a master manipulator, he says. He might, for example, anonymously approach someone for a small favour – “We just need directions to a forum” or “Point us to docu-

mentation on something.” Now he has not only established contact, he also owes the person. He might repay this debt by passing on some useful bit. Maybe the hacker asks him to recommend a new server for spam. “All I have to say is ‘I don’t know much about spam, but I know you can buy good servers in this legitimate business.’ Now we have friendship. We can engage in conversations. Why not? We don’t have to talk all about work. I’m going to ask about family. I’m going to say, how do you feel about what’s going on in Ukraine, or what’s going on with something in politics. It’s important not to disagree.”

The files Holden keeps on international hackers are stamped CONFIDENTIAL. They are a record of suspects and known criminals. In some of the files are the hackers from October 2013 whom Holden and another researcher discovered had broken into Adobe Systems and stolen 3 million customer credit-card records, along with login data and source code for several titles, including Acrobat – a significant theft because of the potential to invite new waves of viruses through popular software.

In more of the files: the criminals who hacked a limousine-software company and leaked credit-card numbers and embarrassing details about 1 million customers, including athletes, politicians and movie stars. Holden found them in November 2013.

In still others: the criminals from Eastern Europe who broke into and stole a cache of data from the USA’s National White Collar Crime Centre, the non-profit that helps law enforcement investigate and prevent cybercrime.

The total number of hacker dossiers, in all, is about 6 500.

EVERYONE CAN SEE MOST OF THE INTERNET, Holden says, but only some people can find the rest, the so-called Deep Web that’s not searchable by Google. The Deep Web is hundreds, perhaps thousands, of times larger. Much of it is benign – private company sites and such. “And then there is the black part of the Internet,” says Holden – the Dark Web, or Darknet. He enters it on a browser that makes him anonymous and untraceable.

“I’m gonna show you a hacker forum from the inside out,” he says, scooting in his chair. He calls up a discussion board, types in two passwords, and gains administrator status, meaning he can move godlike through the forum and read private conversations. A standard board appears, new threads in yellow: “Plastic and Documents.” “Passports.” “All About Phreaking,” or phone hacking.

“They are not giving away kittens or free hugs,” he says.

This is the black market?

“It’s one of many,” Holden says. “We know of maybe 800. We hold seats at many of them.”

What happens if, say, your MasterCard was vacuumed up in the breach last Christmas at a big department store? Holden clicks on another site and up pops a giant picture of a credit card. He logs in. A list appears of Platinum MasterCards for sale, with names, security codes, expiration dates. They are for sale for \$5,20 (about R57) each. “Shop all you can!” Holden booms.

Once Holden uncovers evidence of theft, he has several options. If instructed by his client, his firm can pay to get information back – like a ransom – though he doesn’t like that option because it encourages more theft. Once, when his firm caught hackers siphoning

BY EARLY LAST YEAR, WHEN THE RUSSIAN GANG WAS BAGGING UP TO 100 MILLION STOLEN PASSWORDS AT A TIME, HOLDEN WAS THE FIRST TO KNOW.

information from a client, Holden seeded the illegal download with bad data, spoiling its value. Sometimes, hackers simply hand him information, ratting out others. “We actually see hackers hack each other,” he says. “It’s competitive.”

While we’re talking, a CNN producer calls. Holden apologises and politely asks me to leave – then puts her on speaker-phone loud enough for me to hear. The question is about hackers stealing frequent-flyer points. “Is this something you think is the next frontier of data theft?” she asks.

“We are already seeing this,” Holden tells her. “For six to 12 months.” He begins a long, detailed explanation. The producer sounds like she’s trying hard to keep up.

These forums Holden visits, these passwords – how does he get this access? He has required, as a ground rule, that I agree not to name any of his 100-plus clients, which he says include brand-name oil companies and Internet firms, nor to reveal his exact sources and methods, which could compromise his work.

“Hackers share these things,” he says. He pauses. “We have good, friendly relationships with them.”

WHEN HOLDEN WAS 5, in 1979, his parents tried to emigrate to the United States from Ukraine, then a Soviet republic, and were denied. Once a citizen applied to leave and was blocked, the USSR became a difficult place, but Holden and his family were trapped.

Seven years later the Chernobyl nuclear power plant melted down north of Kiev, leading to mass evacuations. The disaster was the family’s ticket out. They fled to Moldova, then reached a temporary location in Italy where they waited to emigrate. Holden, then 14, was put to work cutting grape vines and moving rocks out of farm fields. He missed a year of school.

Eventually the family made it to Wisconsin, where his parents legally changed their surname to better assimilate. (Holden declined to reveal what the old one was, to protect relatives back home from repercussions related to his work.) Holden was an awkward, husky kid, a loner who struggled so much with English that teachers tried to hold him back a grade. After being assigned to eighth grade, he went home and told his parents he wasn’t going back. The school bumped him up to

ninth. He also felt deeply confused about the United States, which he had always been taught was evil. Suddenly he was told he'd been lied to his whole life. "There was no guidebook *Coming to America for Dummies*," Holden says.

Both his parents had been engineers in Ukraine, and they raised Holden and his brother, Rich, to use their brains. Holden became so skilled at chess, his parents hired a private coach. Their father gave his sons almost weekly engineering puzzles: *Let's figure out why water freezes at this temperature, and how much energy it gives off.* The lessons stuck: today they're both professional problem solvers – Rich is an assistant professor of informatics and computing at Indiana University-Purdue University, Indianapolis.

As Holden came of age, so did the personal computer. He began to realise its power when a high school biology teacher allowed students to bring one 75 x 125 mm card of notes to the final exam. Holden printed 30 pages of terms and equations on one card, in 2-point font. He graduated six months early.

But Holden has never forgotten how it feels to be a perennial outsider. The frustration and lack of opportunity – it was palpable in the men in south central Russia with whom he connected about 18 months ago. There were about a dozen low-level spammers, all in their 20s, led by a man they called Mr Grey. Holden chatted up the gang anonymously. At first Mr Grey's group was only after old lists of emails they could get cheaply. But eventually the group became more ambitious, acquiring logins and passwords to access social-media sites, a more effective way to spam because messages look like products endorsed by friends.

By early last year the gang, which Hold Security dubbed CyberVor (*vor* is Russian for "thief"), was bagging up to 100 million credentials at a time, including data fresher than the old email lists. Holden learnt that CyberVor was controlling a botnet – an army of computers run by malware, or malicious software. When an infected user visits a website, hackers use the botnet to see if the site is vulnerable in a way that would allow them to steal data from it. When CyberVor ended up with the largest data theft ever, Holden was the first security expert to know.

His parents raised Holden and his brother to use their brains. Their father gave them almost weekly engineering puzzles: the lessons stuck, and today they're both professional problem solvers.

HOLDEN WANTS A STEAK. After he eats a thick Midwestern slab at a downtown Milwaukee steakhouse, he takes me up to a penthouse bar. He'd mentioned the great views – across the city to Lake Michigan and beyond – but clouds blot out the skyline. He leans back in a tall, upholstered chair, and after a sip of a rum and Diet Coke he says, "Let's do an experiment." When he visited southern Italy, he noticed the manhole covers were square. He asks me, why would they make square manholes?

I sit for some time in uncomfortable silence. Finally, I answer: Old Italy equals cobble streets. A round manhole wouldn't fit among blocks, but a square one would.

He seems a little surprised, but the correct answer is not what interests him. Look how you're folded up in your chair, he says. You're not relaxed. On the other hand, he points out, your head is tilted down and to the left – you're thinking, hard. When he interviews people for jobs, he's interested not just in the answers but in how they react to stress. As he puts it: "We have 'oh my God' moments quite often."

For much of his boyhood, Alex Holden was unsure of his place in the world, his family moving from country to country as if fleeing, the boy searching for an acceptance he rarely felt. When his loneliness led him to something he was good at, that made him feel good, he used his knowledge to do good in return. Now he looks for people who feel the way he did about their place in the world, but who have succumbed to the alienation.

The morning after the bar, Holden shows me one of the confidential dossiers. Here is the criminal's online alias, home address, marital status. Here are pictures – of the hacker dancing, at the beach, with friends. One of them, a young Eastern European, was looking for programming work in 2013. Unsuccessful, he helped design the malware that shredded the network run by discount chain Target that Christmas season, stealing personal data from as many as 70 million customers. Thieves used some of the stolen credit-card numbers to go on spending sprees; banks imposed tight debit-card restrictions, further infuriating travellers and holiday shoppers and inflaming fears about the safety of online information and identities. But Holden echoes what he said during the experiment in the bar, about not getting emotional. "If you're angry about this," he says, "you lose your good judgment."

About 10 years ago Holden was auditing a large financial institution's network. He found a gaping vulnerability. He could see that he could gain access to \$272 million (about R3 billion) as an electronic funds transfer," he says. He was alone, just him and a whirring computer. "At that point, your eyes kind of glaze over. And you think about it. This is bigger than most lotteries." For 10 long seconds he sat staring at the monitor. *Wow, I don't even know what \$272 million would look like.*

Then he blinked, shook off the daydream, documented the bug, and got back to work. **PM**

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PM TESTED

CloudGate

Boxing clever

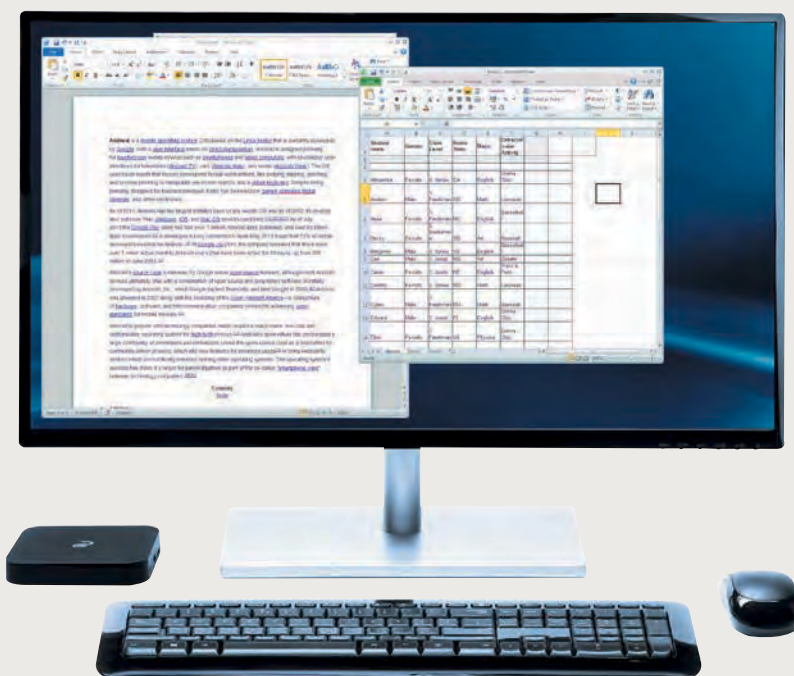
Miniature computer-in-a-matchbox alternatives to mainstream personal computers are becoming more and more refined and capable. That's not surprising, given that most people would find the likes of Cotton Candy perhaps underpowered and Raspberry Pi too geeky and DIY for their tastes. The really tiny ones are also much more dependent on peripherals. In a business environment, that's an important consideration. A device such as CloudGate inherently makes a lot more sense if the idea is to sell to the mass market. It doesn't hurt that it looks like a scaled-down version of the Mac Mini. On the downside, it still needs a keyboard, mouse and screen, which puts it at a disadvantage compared with devices such as the Chromebook.

So what does The CloudGate bring to the party, then? For starters, a reasonable amount of horsepower, with a quad-core 1,6 Ghz processor and 2 GB RAM. Solid state storage of 8 GB is provided and there's an SD Card slot. The interesting bit lies in the "cloud" part of its name, which refers to its preferred storage location for your work. It's also possible, via CloudWare software, to set up a virtual Windows environment.

Straight out of the box, the CloudGate is practically ready to roll. Set-up couldn't be simpler: power it up using the wall wart adaptor, hook it up to a screen via its mini HDMI port and then, via a USB port (there are three plus a micro-USB) to a mouse and keyboard – and that's more or less it. Fire up the Android 4.2 Jelly Bean OS, select your screen resolution (it supports Full HD) and you are good to go, with plenty of apps to choose from.

Despite being only a little larger than really mini-sized computers, the CloudGate has connectivity options that would embarrass many bigger devices. It's big enough to have SPDIF and Ethernet port included in its configuration, with built-in Wi-Fi and Bluetooth for alternative network access. The ready availability of cloud storage space means that the device's relative lack of onboard storage isn't really a problem. It's also sparing with resources, consuming 10 W. Overall, a good option for those on a budget.

- ✓ Convenience; voice prompts; HRM accuracy; app features
- ✗ A little lightweight



JUST THE FACTS

DIMENSIONS (H x W x D)	20 x 128 x 128 mm
WEIGHT	225 g
IN THE BOX	Power supply, HDMI cable, OTG USB cable, USB cable
PROCESSOR	Quad core 1,6 GHz
CONNECTIVITY	HDMI, USB 2.0, Micro USB, SD, RJ45, SPDIF
POWER CONSUMPTION	10 W
CONNECTIVITY	Wi-Fi 802.11b/g/n, Bluetooth, Ethernet
RAM	2 GB High-Speed
STORAGE	8 GB SSD, Mini SD up to 32 GB
PRICE	R1 999

TESTED





Logitech G910 Orion Spark

Getting clicky

It won't shoot lasers and doesn't do helluva much for world peace, but Logitech's greatest gaming keyboard is designed to have you lording over the LAN. If you're in with the mechanical keyboard crowd then you should know that the Cherry MX switch (the bit under the key cap that goes "click" and registers the press) is the gold standard. Well Logitech has something to say about that and developed a proprietary Romer-G switch for the G910. On test we found the new switches to be very fast and accurate, but a bit quiet for typing out large swathes of text.

The biggest problem a serial typist will have, however, is the peculiar key layout. The asymmetric slant in of the Qwerty board is left-hand biased and feels awkward when approached with the right hand. Great for late night raids, terrible for touch typing.

No fewer than nine macro keys are floating around the edges, which means you can switch profiles on the fly. Coupled to this is an almost infinitely customisable lighting scheme to pave your rainbow road to victory. We love the one USB cable (competing products demand two USB ports for power and connectivity) and the built-in smartphone dock comes into its own when used with Logitech's home-baked ARX



THE ESSENTIALS

KEY TRAVEL: 3.14 mm bottom out, 1.92 mm actuation

IN-KEY ROLLOVER: >10 keys

WEIGHT: 1,5 kg

Control app that feeds you critical info about your PC's vitals and performance.

Keyboard software unleashes the true potential of the G910 by scanning your machine for games and automatically downloading the keyboard profiles for them. You can customise almost everything on this board, but you also need to be serious about your gaming to apply – this will not work well as a general use keyboard, despite the claimed 70-million strokes key longevity.

PACSAFE CAMSAFE V8 ANTI-THEFT CAMERA BAG

City slicker

Urban photographers face completely different challenges to those shooting in the bush and that's where the Camsafe V8 shoulder bag comes in. Effectively a portable padded safe for camera gear, it boasts a number of security features to keep long and sticky fingers off your stuff. Just as importantly, the bag's deep, slim profile and well-designed shoulder strap lets you slip through bustling sidewalks and access your gear with ease – something that can't be said for bulkier designs.

The bag's lower front, bottom and side panels have built in stainless steel wire mesh screens to thwart slash-and-grabbers. The strap is reinforced with stainless steel to prevent it from being cut and features a dual release security buckle that requires two hands to operate. This great feature lets you secure the bag around a table leg, for example, allowing you to enjoy a meal without having to ensure your gear's still there.

Finally, both the top easy-to-operate boomerang handle and the side pocket have robust lockdown zips to discourage pickpockets. There's also an RFID blocking pocket, preventing high-tech thieves from accessing info on credit cards and passports. And to protect your gear from the elements, there's a rain cover discreetly stashed underneath the bag.

On the camera front, the main compartment can accommodate most DSLRs, a few lenses and an external flash. Plus, the side pocket is large enough for all the peripherals you invariably need to cart along on a shoot. There's also a sleeve at the back to accommodate tablets and two elastic side pockets. The layout's simple, but it works. Do we like it? So much that we bought one. Price: about R1 400. Visit duesouth.co.za





MYUNIWAY CYCLE

Mile glider

Whether it's because you have gone green, have succumbed to peer pressure, or simply can't afford the petrol (or e-tags) anymore, you are probably using public transport of some kind to get to work these days. For all the benefits, there is one universal drag: the train/taxi/bus doesn't stop at your office door. This is where the myriad last-mile commuting solutions have tried to start a revolution. The latest through our offices is the MyUniway electric unicycle. We were scared to test this one; even more so when we saw it had no seat.

MyUniway uses the same self-balancing wizardry you find in a Segway, but on one wheel. So you're in control of roll and yaw. With a top speed of 16 km/h, a range of 15 km and a recharge time of only

one hour, your last mile is sorted if you manage to scale the steep learning curve. Much like a bike, if you're not moving fast enough you fall over. The trick is to trust the machine (something every fibre in your body will advise against), lean forward and let the motor propel you across the suddenly much harder looking pavement. At that point physics and the single-axis self-balancing inverted pendulum motor will keep you upright. Unless you forget to trust the machine. Which happened to us, a lot.

After two days and only one actual fall we mastered a new skill. And then we remembered how long it took to learn to ride our first bicycle/motorcycle/car/horse, it suddenly didn't seem hard at all in that context. Gliding along at a comfortably efficient speed with zero effort and a lovely breeze in your hair the product seems like a step in the right direction to solve the last-mile problem. It weighs 9,8 kg though.

MyUniway is an eye-catching investment if you are willing to make the mind shift and endure. It may even get the kids outside.



THE ESSENTIALS

BATTERY: 174 Wh LiFePo

RECHARGE TIME: 60 minutes

RANGE: 15 km

TOP SPEED: 16 km/h (pedals tilt back to stop you losing balance and limits speed)

WEIGHT: 9,8 kg

CAPACITY: 120 kg

PRICE: R7 999,00

PM



WHEELS



Compiled by
ANTHONY DOMAN
anthony@ramsaymedia.co.za

FORD MUSTANG

THE BEST YET

The Ford Mustang just celebrated its 50th birthday.

Over the years, Ford dallied with a turbocharged four-cylinder (the '80s SVO) and an independent rear suspension (the 1999 – 2004 SVT Cobras). But if you wanted a hot Mustang, the essential recipe was the same last year as it was in 1964: V8 in front, solid axle dancing around out back.

But after a half-century the Mustang was due for some modernisation, and the redesigned 2015 model sends the franchise in a new direction. Independent rear suspension is now standard across the lineup, and a 2,3-litre EcoBoost four-cylinder joins the V6 and V8 models. Turbocharging and independent rear suspension? Is this a Mustang or a BMW?

Don't laugh. Ford is confident enough in its new suspension that it held the Mustang's global launch in Los Angeles, where the bumpy canyon roads sent the outgoing solid-axle car constantly lunging towards the guardrail. Instead, the new V8-equipped GT drives more like the old BMW M3 than it does a Camaro, or its own predecessor, for that matter. The 32-valve, 5-litre V8 is smooth and high-revving, cranking out 325 kW at 6 500 r/min. And the redesigned rear suspension has no trouble deploying that power. The latest GT is also quieter inside than the old one, with the EcoBoost model broadcasting synthetic engine noises through the stereo system. Come to think of it, BMW does that too.

The Mustang's value-leading V6 returns with 224 kW and 380 N.m, but the more intriguing engine is the turbocharged four-cylinder, which has 7,5 extra kilowatts and a healthy 433 N.m of torque. Ford is positioning the EcoBoost as a stepping-stone to the GT, offering

a performance package that's unavailable to the V6 caste. But there's some price overlap between an optioned-up EcoBoost and a basic V8-powered GT. You can have amenities or power, but not both.

What the four-cylinder model gives up in power it makes up for in mass, weighing 1 590 kg – about 90 less than the GT. This gives the EcoBoost the most balanced front-to-rear weight distribution of any Mustang thus far: 52/48. The EcoBoost feels noticeably more agile than the GT, especially when you pair the four-cylinder with the Performance Package, which brings stiffer suspension, appropriate rubber and a 3,55:1 final drive ratio. It's a lively, fun car.

In either guise this is the first Mustang that feels as if its chassis could handle a lot more power. Driving the outgoing 494-kW Shelby GT500 was an exercise in fear management, like riding a Radio Flyer wagon down the side of K2. This one should be able to deploy Shelby-calibre firepower on a road course, not just at drag strips.

Overall, the new Mustang makes its Big 3 muscle car equivalents from Chevrolet (Camaro) and Dodge (Challenger) seem especially barbaric. It's poised and polished – perhaps to a fault. Cars of this ilk ought to be a little uncouth, a sentiment quietly affirmed by a Ford engineer at the launch who suggested an easy GT hack. Within the sound-conducting tube that runs through the firewall, there's a piece of sound-deadening foam. To ratchet up the noise, just remove the foam. Refinement is all well and good, but sometimes you need a little less BMW and a bit more Boss. *By Ezra Dyer*

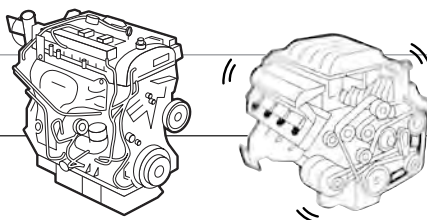
The new Mustang feels like it could deploy Shelby-calibre firepower on a road course, not just at the drag strip.



AND ANOTHER THING!

A BARROOM RANT ON PUSHRODS

Pushrods – they're outdated, right? Overhead cams won. Everybody wants overhead cams, four valves per cylinder, variable blah blah blah. Pushrod engines are a relic from the '50s. You've got a cam down there in the block, only two valves per cylinder, not much you can do with that. Not much except 527 kW. Yeah, the SRT Hellcat Hemi, the most powerful engine Detroit's ever built. That thing's got pushrods, and it seems to do all right on power. Ditto the GM stuff, the Camaros and the Vettes. Fine, pushrod engines aren't smooth. Fire one up and the car shakes like it's impatient. Because it is. This isn't some computerised make-believe. This is mechanical fact, a reminder that you are piloting a machine that's propelled by explosions. A pushrod V8 is a visceral thing, a cherished American tradition, and if you think otherwise, you hate excellence.



No pushrods: Yawn. With pushrods: America!



THIS CAR STOLE THE LA AUTO SHOW

It's the 2016 Mustang Shelby GT350. The new Mustang's first performance variant, it wears sportier sheet metal and comes specially equipped with active damping, a Torsen limited-slip differential, and a racing-inspired flat-plane crankshaft V8. Expect more than 670 kW and 540 N.m of torque.



JAGUAR F-PACE

HEADING OFF-ROAD

Jaguar has confirmed it will introduce an all-new model to the Jaguar line-up, to go on-sale in 2016, named the Jaguar F-Pace.

Says Ian Callum, Jaguar's design supremo: "We received such an overwhelmingly positive response to the C-X17 concept car last year that we just had to make it a reality."

According to Callum, the Jaguar F-Pace, inspired by the F-Type, represents a perfectly judged balance of performance, style and practicality. "It offers a unique combination of Jaguar sports car inspired exterior design, fused beautifully with a thoroughly practical and spacious luxury interior. The F-Pace is our family sports car."

The Jaguar F-Pace couples class-leading interior space and exceptional on-road dynamics with five-seat usability to produce a true performance crossover. It will encapsulate everything that Jaguar stands for: beautiful design, precise handling, a supple ride, luxurious interior finishes and cutting-edge technology.

Speaking in Detroit, Andy Goss, Jaguar Land Rover global sales director, pointed out that in 2015 Jaguar would celebrate its 80th year. "We have started it by announcing our first performance crossover which we consider to be the ultimate practical sports car – a car that builds on the marquee founding ideals of Grace, Pace and Space to become one of the most innovative Jaguars we've ever developed. The F-Pace has now begun its engineering and development testing programme ahead of the new model going on sale in 2016."

The F-Pace will be manufactured in Solihull, UK. Jaguar South Africa can confirm that the all-new F-Pace will go on sale locally. Further details will be revealed later this year.



FERRARI 458 SPECIALE

ULTIMATE FACTORY HOT ROD

If you were to make a list of all the things wrong with the Ferrari 458 Italia, it'd be a short list. And "not fast enough" wouldn't be on it. Nonetheless, Ferrari tinkered with its signature V8 supercar and built the 458 Speciale, a rolling F1 fantasy that adds 26 kW and drops 90 kg relative to the Italia. The Speciale's 445 kW feels like even more than that, delivered as it is by a 9 000-r/min V8 centrally mounted just behind your shoulders. The interior is stripped to bare metal and made of carbon fibre, reinforcing the race-car vibe. Flick the steering wheel Manettino switch to Race and the active-exhaust system bypasses the silencer every chance it gets, uncorking a howl that will haunt your dreams – the sound of a deity's drill bit boring a hole through the universe. It's the kind of car that makes you want to drive everywhere

with the windows down, winding it up high enough to trigger the LED shift lights at the top of the steering wheel. Tunnels are an event. So are on-ramps. And downshifts, each one accompanied by a perfect throttle blip from the dual-clutch transmission. It would be a goofy name for any other car, but in this case it couldn't be any more apt. This is as speciale as it gets.



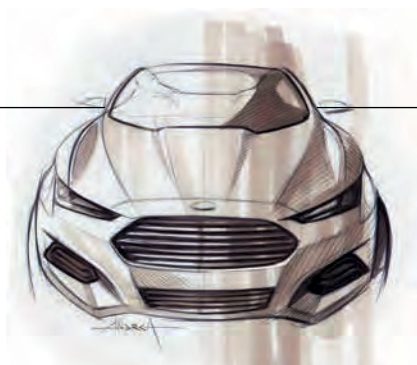
Inspirations: left, CX-17; right F-Type



FORD FUSION

DADCORE

To follow up its success with Kuga, EcoSport and the all-conquering Ranger, the blue oval is releasing a new flagship sedan. If you squint hard enough you can tell your friends that the passing resemblance to the upcoming Mustang extends into some part sharing, but rather wow them with some of the safety tech. Start by explaining how airbags in your rear seatbelts will keep your kids safe, or impress them with the City Stop feature that'll automatically stop the car in the event of an anticipated crash at speeds of up to 50 km/h. Adaptive cruise control will stop you from barrelling up behind slowpokes on the N1, adaptive headlamps stop you from blinding people and making adjustments to your interior lighting is only one of the many talents Ford's Microsoft-based Sync 2 platform brings to the party. It's a solid car that'll get your family to their destination safely and comfortably, and leave you grinning at the fuel pump. Choose from four engines (the 1.5 EcoBoost is evolved from Fiesta ST and pulls like a two litre, and the 177 kW 2.0 EcoBoost is from the Focus ST) and two spec levels (Trend and Titanium), but there's plenty options to make it truly unique.



FORD FUSION JUST THE FACTS

1.5 ECOBOOST TREND

ENGINE: 1.5 litres, turbocharged 4 cylinders

OUTPUT: 132 kW and 240 N.m

ECONOMY: 7,4 litres/100 km

SAFETY: 7 airbags, ABS with EBD, traction control, hill launch assist, ISOFIX child seat anchors

CO₂: 173 g/km

2.0 ECOBOOST TREND

ENGINE: 2,0 litres, turbocharged 4 cylinders

OUTPUT: 149 kW and 300 N.m

ECONOMY: 7,5 litres/100 km

SAFETY: 7 airbags, ABS with EBD, traction control, hill launch assist, ISOFIX child seat anchors

CO₂: 174 g/km

2.0 ECOBOOST TITANIUM

ENGINE: 2,0 litres, turbocharged 4 cylinders

OUTPUT: 177 kW and 340 N.m

ECONOMY: 8,5 litres/100 km

SAFETY: 7 airbags, ABS with EBD, traction control, hill launch assist, ISOFIX child seat anchors, front parking sensors, rear view camera with parking sensors, adaptive cruise control

CO₂: 187 g/km

2.0 TDCI TITANIUM

ENGINE: 2,0 litres, turbocharged diesel, 4 cylinders

OUTPUT: 132 kW and 400 N.m

ECONOMY: 8,5 litres/100 km

SAFETY: 7 airbags, ABS with EBD, traction control, hill launch assist, ISOFIX child seat anchors, front parking sensors, rear view camera with parking sensors, adaptive cruise control

CO₂: 124 g/km

→ No manual car in model line-up. TDCI gets dual clutch Powershift gearbox

→ Rear seatbelt airbags to be released in coming months, a world first in the international model.

→ Adaptive cruise control will keep the car at the chosen distance to the car ahead.



INTELLIGENCE ON THE GO

SMARTER CARS MAKE THE CONNECTION TO THE DRIVER'S CONSUMER-TECH WORLD – AND TO THE CLOUD

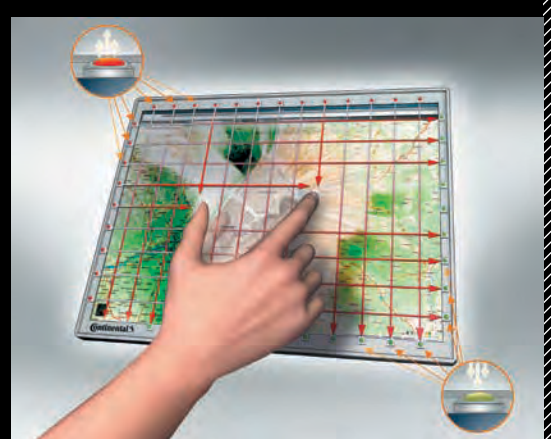
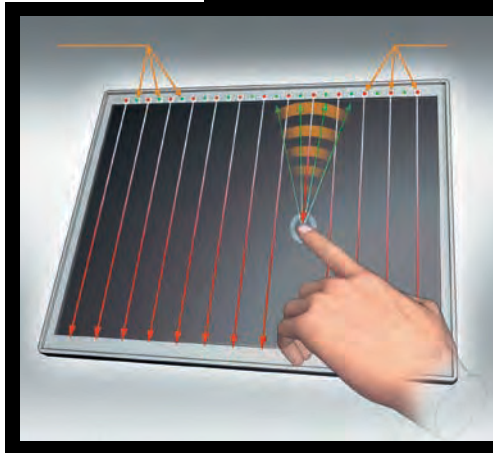
Jostling for headline space at CES 2015, alongside the Samsungs, Sonys and Apples of this world, was a host of brands familiar from other, rather different trade shows: Mercedes-Benz, Ford, GM and their counterparts from across the globe. Clear evidence of how the automotive industry has embraced the cloud in a big way, the vast annual consumer tech show in Las Vegas provided insights into how seriously the carmakers are taking the convergence of mobility and their customers' lifestyles.

One of those at the forefront of these technologies is Continental, a company perhaps better known among the general public as a producer of tyres. Less well known is its significant research and development capacity in vehicle systems. It has a potentially crucial role to play in new forms of mobility, notably autonomous drive. More immediately relevant, though, is its input into how we interact with our cars. That's the focus of Continental's interior division, which develops information management and intelligent transport systems. Its portfolio ranges from instruments to multifunction displays and head-up displays, control devices, vehicle access and tyre information systems, radios, infotainment and operating systems, climate control units, telematics solutions and services, software, and cockpits.

Touchless

We're all familiar with electronic gadgets that support multitouch gestures. You can get that functionality in a car – at a price – via a touchscreen. But there's an obvious, cheaper way to do it: Continental is proposing an infrared

"We are demonstrating how the online world is rapidly evolving to make our vehicles safer, more appealing, and more efficient. That's why we are showcasing ready-to-market solutions for the intelligent vehicle" – Helmut Matschi, head of Continental's Interior Division.



Infrared curtain uses twin LED rows to make gesture control possible. eHorizon (top) can "look up the road".

curtain to bring this feature to the mass market.

Operating in much the same way as those little black boxes that project virtual keyboards for smart mobile devices, what the company calls "a tapestry of infrared light" makes multi-touch

gestures possible even in small, affordable vehicles. Not only does it make expensive touch displays unnecessary, it has one huge advantage: it works even with gloves.

"Back in 2011, we showed that an infrared curtain can turn any surface in the car interior into a user interface," says Fook Wai Lee, display developer at Continental in Singapore. "We have now developed this technology to the point where it also recognises typical multi-touch gestures as input." Those gestures include the familiar swiping, zooming and pinching.

The technology even extends the recognition possibilities: capacitive touch screens, as known from modern smartphones, cannot be used with standard gloves. Special gloves are necessary to be able to use standard touch screens with gloves. "With our infrared technology, there is no need for special gloves. Our infrared curtain is able to detect touch gestures by gloved fingers," says Fook.

The infrared curtain is built from an array of infrared light sources (two rows of LEDs) on the sides of the display. Electronics of the human machine interface (HMI) recognise the finger's positions from the blocked light. "The challenge is in the integration: our goal is an infrared light source that is sticking out only minimally over the display surface, yet still recognises all desired multi-touch gestures," explains Fook Wai Lee. Expect to see this in production in 2017.

Back in today's world, touchscreens with enhanced functionality and connected



Multi-gesture recognition (top), smartwatch and touchpad all feature in Continental accessibility options.

services are big. Continental's curved OLED Touch Display delivers strong contrast levels capable of displaying bold colours without background lighting in a curved display that means it can be integrated more easily into the centre console.

Seeing ahead

In collaboration with IBM and the location cloud company HERE, Continental has transformed the digital map into a high-precision, constantly up-to-date sensor that can be used for much more than just navigation. eHorizon is dynamic, so it can incorporate changing events and updates such as weather, traffic or construction sites on the route, using the principle of crowdsourcing to find – and supply – data in a constant exchange with other roadusers via the cloud. Even the company's hybrid system is able to benefit from the cloud interactivity, which provides energy management for the most efficient operating strategies during the drive. It can work out in advance when to coast or regenerate energy, based on “looking up the road” to see driving conditions.

Virtual repairs

It's not just the driver and other occupants of a car that can benefit from connected services. Continental's “Connected Technician” uses Augmented Reality in a tablet application that wirelessly does diagnosis and repair. Not only does the mechanic not need to go hands-on with your car, he doesn't even need to plug in a diagnostics machine. The app delivers all the information necessary for each step, from work instructions to faulty parts or the exact tool needed for a certain job, allowing the technician to focus on the vehicle. And yes, they *have* thought of little problems, such as replacing the clutch when all you wanted was a blown lightbulb changed. The system integrates with dealer management systems to ensure that the technician is working on the right job. A full-featured diagnostics runtime automatically recognises the vehicle type, detects faults and provides the complete technical information available for the car. There's even voice input and feedback enable technicians to remain hands-free.

HONDA NSX

THE WAIT'S OVER

Tantalising glimpses of what might be, in the shape of concepts exhibited at show after show, have given way to reality. And it looks like it's been worth the wait.

It's hard to believe that the production version of the new Honda NSX comes a quarter of a century after the original.

Deliveries of the twin-turbocharged mid-engine sports hybrid supercar are expected to start late this year.

As with the original, Honda wants to bring something different to the supercar party. So what's that something different?

Whereas the original was the first supercar with an all-aluminium body, its successor's lightweight body, uses various materials featuring world-first processes. Like the original's, the 2015 NSX engine is a V6. It is mated with a 9-speed dual clutch transmission and three-electric motor Sport Hybrid system.

Describing its concept of the NSX as a "human-centred supercar", Honda says it puts the driver first in every aspect of its design. The car's design process took three years, with design input from all over the world fed into the company's US development centre.

The production version of the NSX is slightly longer and wider than the concept's, to accommodate the new longitudinally mounted twin-turbo V6 and 9-speed DCT. In Honda's words, the overall effect is of a slightly more cab-forward package. However, the body shape has been optimised for airflow management that combines downforce and cooling. Changes from concept to final body design include modified hood vents, new front fender vents, modified side air intakes, and an optimised deck spoiler.



HUMAN SUPPORT COCKPIT

The NSX instrument cluster features a dynamic TFT display that responds to changes in the driver-selectable Integrated Dynamics System with pertinent graphics and information. Under the handcrafted leather dash panel is the exposed midframe – a functioning chassis structural member that reflects the design aesthetic of a naked sport bike. An ultra-thin, yet super strong A-pillar design and low-mounted instrument panel minimise obstructions to the driver's view of the road.

ADVANCED MULTI-MATERIAL BODY

The NSX's bodysell of aluminium and sheet moulding composite (SMC) snuggles around an aluminium space frame and carbon fibre floor. The ultra-high-strength steel and other cutting-edge materials also used required advanced joining methods. In what's said to be a world first, casting and forging technologies are combined to enable significant weight reduction.

SPORT HYBRID POWER UNIT

The V6 engine uses a race-inspired compact valvetrain and dry sump lubrication system to help lower the centre of gravity. The rear direct-drive electric motor, housed between the engine and transmission, supports acceleration, braking and transmission shifting performance. The NSX's front wheels are driven by twin independent high-output electric motors that deliver instantaneous torque response and dynamic left-to-right torque distribution. The NSX uses its front electric motors for dynamic torque vectoring in addition to enhancing acceleration and braking performance.



BENTLEY BENTAYGA BACK TO NATURE

Bentley's all-new and ground-breaking luxury SUV (pictures show the prototype released earlier) is set to be revealed to the world later this year and a name has been chosen: Bentley Bentayga. This sector-defining SUV will be able to introduce Bentley's renowned modern British luxury to limitless destinations with an impressive combination of on- and off-road performance.

The natural world, along with the company's founder, inspired its name. To the north of Bentley's birthplace in England, is the dramatic beauty of the Taiga, the world's largest transcontinental snowforest. To the south, the rugged peak of the Roque Bentayga in the subtropical Canary Islands draws attention from all directions and a challenging climb rewards with spectacular panoramic views of a rich and diverse landscape.



NEED NEW WHEELS? BEST BUYS FOR 2015

What's the best new vehicle in the market? There isn't one, but 12 of them. CAR's editorial team has selected the best vehicles in 12 categories of the South African market, ranging from the best budget car right through to best performance car, SUV and double cab. The winners list is the product of rigorous testing, discussion and deliberation because you deserve to have the most comprehensive buying guide at your disposal. **Let CAR's March 2015 issue help you choose the best vehicle.**

in association with





PORSCHE CAYENNE TURBO S PORSCHE 911 TARGA 4 GTS

SOUND AND FURY

To crack the 8-minute barrier on the North Loop of the Nürburgring in Germany, you need to possess superior driving skills and be sitting at the wheel of something at least as potent as a Dodge Viper, Nissan Skyline GTR – or an SUV, it seems. Provided that the SUV in question is the new Porsche Cayenne Turbo S.

The Porsche, unveiled at the 2015 North American International Auto Show in Detroit, is the fastest vehicle of its type around the legendary circuit: 7:59,74. For the record, the outright best at the time of writing this is 6:48 by the Radical SR8 LM.

Outwardly similar to less powerful members of the Cayenne family, the Turbo S features a change to its engine aspiration set-up. Turbochargers are now integrated in the exhaust manifolds of this range-topping newcomer. It's said to benefit responsiveness and provide a 15-kW boost over its predecessor's power peak. Outputs are now 425 kW and 800 N.m, enabling the Turbo S to reach a top speed of 284 km/h and reach 100 km/h from rest in 4,1 seconds.

Still not convinced? Add the optional sports exhaust. The system's switchable sound "symposer" transmits the V8 rumble more audibly into the cabin.

A more visually obvious newcomer on the Porsche stand at Detroit was the 911 Targa 4 GTS. This is the first time the GTS is available in a targa shape, albeit slightly wider at the rear to accommodate the wider wheels required by the 4wd drivetrain. It is supplied as standard with a more powerful 320 W engine and Sport Chrono package. Incidentally, the 911 Targa celebrates its 50th anniversary this year. Top speed is over 300 km/h and the Targa 4 GTS sprints from zero to 100 km/h in 4,1 seconds.



VOLVO S60 CROSS COUNTRY

INTO UNCHARTED TERRITORY

Volvo says it is stepping up to meet the demands of its core customers with the unveiling of the Volvo S60 Cross Country at the Detroit Auto Show.

Like the recently introduced Volvo V60 Cross Country, the Volvo S60 Cross Country shares an increased ride height of 65 mm and comes with the same all-wheel drive underpinnings of its sibling. This makes it effectively, according to Volvo, the only truly stylish all-road sedan crossover on the market. The Volvo S60 Cross Country will also be delivered with front-wheel drive in Europe and selected markets.

"The Volvo S60 Cross Country is the sole contender in the crossover sedan segment. We have identified a clear niche in the market for a more capable sedan with rugged styling cues and a higher stance. The Volvo S60 Cross Country will appeal to people who are searching for an exciting and capable sedan, while enjoying the clear benefits that a crossover offers," says Alain Visser, senior vice president sales, marketing and customer service.

Reflecting Volvo's love of nature and Scandinavian heritage, the Volvo S60 Cross Country offers both 18- and 19-inch wheels with high profile-tyres that add both comfort and all-road aesthetics, reduce road noise, and add increased wheel protection when needed.

The Volvo S60 Cross Country will launch with a full powertrain program, ranging from a powerful T5 all-wheel drive petrol powertrain delivering up to 187 kW available in the US, Canada, Russia and Europe, to the front-wheel drive 140 kW diesel D4, based on Volvo's class-leading Drive-E powertrain architecture, offering a blend of efficiency and performance in European markets. A diesel all-wheel drive D4 will also be launched based on the proven 2,5-litre 5-cylinder diesel engine.

Volvo Car South Africa has a strong local line-up – especially with the all-new Volvo XC90 and V60 Cross Country arriving in SA this year. At this stage there are no plans for the Volvo S60 Cross Country will to be sold locally.

PM





When you dump used motor oil into drains, or dispose of it unsafely, you're not only threatening the environment, you're threatening your well-being too. Used oil is a hazardous waste that can contaminate drinking water. Always use ROSE approved collectors and recyclers to dispose of your used oil.



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SKILLS



THE NO-FAIL BREAK

1. Centre the cue ball opposite the triangle.
2. Aim directly for the lead ball.
3. Hit the cue ball just above its centre to impart spin.

HOW TO

WIN AT BAR GAMES

A guide to using math
and physics to become king
of the neighborhood.

COME MARCH, WHEN YOU'VE SEEN every last movie or series and burned through every last ounce of holiday joy, and finally paid off your December debt, the only thing saving you from the boredom of the daily grind is your PlayStation. Or the local bar. Anywhere you can fraternise with other humans, and use your wits and a basic understanding of geometry and physics to defeat your friends in pool, darts, air hockey, table-tennis and Foosball. Make no mistake:

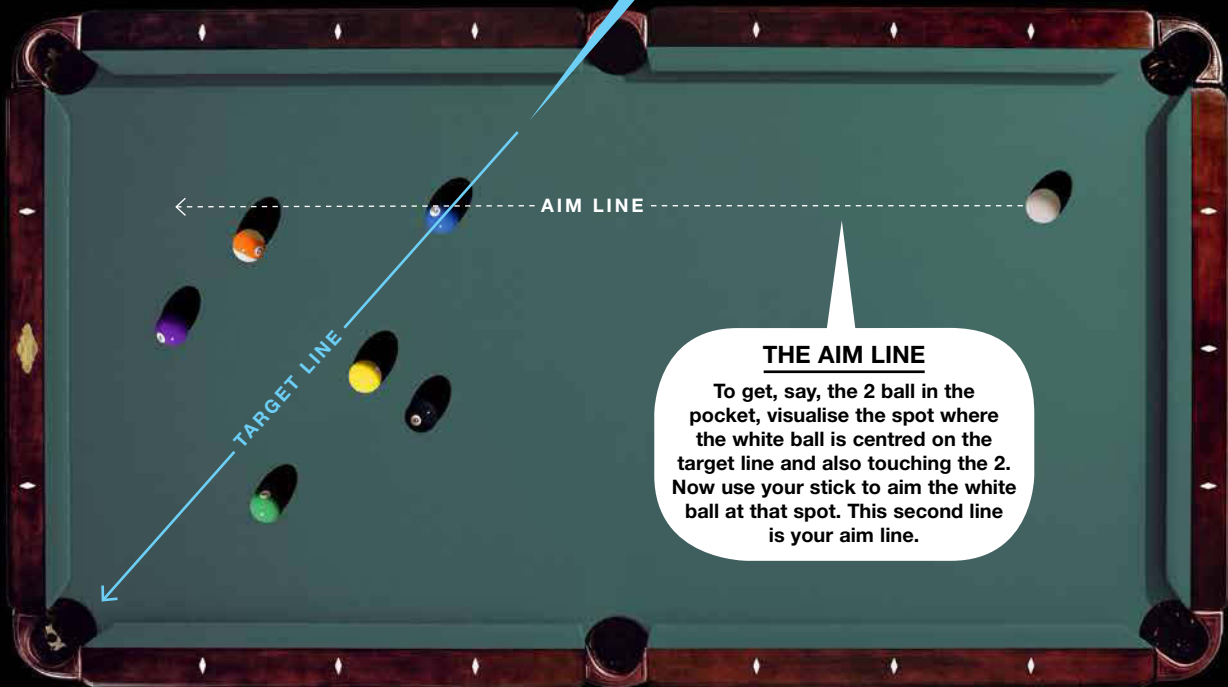
under these conditions, bar games are sporting events. The people who win them are champions. Champions at defeating crushing boredom while sipping a craft beer and wearing a rugby jersey, maybe, but champions nonetheless. And with our help, you can be one of them.

Billiards table, dartboard and hockey table courtesy of David Roeder, Blatt Billiards, New York City

THE RULES OF BAR GAMES: No fighting ● No gloating ● No puking ● All insults shall remain relatively civil. ● The first two beers

THE TARGET LINE

You probably already use your cue stick to make a line from your chosen ball to the pocket you want it to go into. Everybody does this. This is a target line. For any given ball and pocket, there is just one target line.



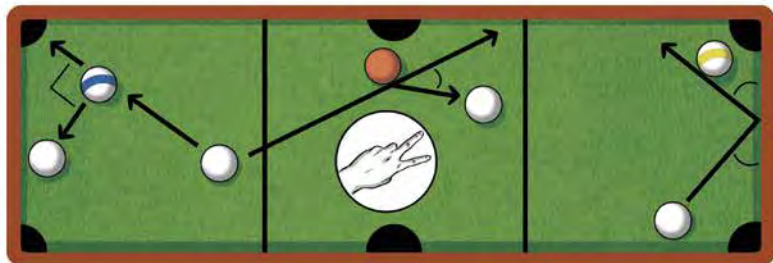
THE AIM LINE

To get, say, the 2 ball in the pocket, visualise the spot where the white ball is centred on the target line and also touching the 2. Now use your stick to aim the white ball at that spot. This second line is your aim line.

• POOL

LINEAR MOMENTUM

Peel back the layers of fog that stand between you and everything you learnt in high school. You may remember such topics as Euclidean geometry and kinetic energy from textbook chapters that featured photos of pool tables. The low-friction, two-dimensional environment of the game – a rectangular felt table that allows smooth-surfaced balls to slide or roll – is an ideal one in which to use these concepts in real life. We asked David Alciatore, professor of mechanical engineering at Colorado State University, for a few tips.



- Knowing what your cue ball will do after it makes contact with an object ball helps you avoid scratching (also, cursing and throwing things). If you strike firmly in the centre of the cue ball, it will slide along the felt rather than roll. When a sliding white ball makes contact with an object ball, the two will always separate at an angle of 90 degrees.

- Now if you hit the white ball softly and just above centre, it will roll instead of slide. When it strikes another ball, its path will divert about 30 degrees. To estimate this, make a V with your middle and index finger and point your middle finger along the aim line. Your index finger will show you the rough trajectory of the cue ball after impact.

- Bank shots are about as simple as geometry gets: when a ball hits a bumper, the angle at which it shoots off mirrors the angle at which it came in. So if you're trying to hit the white ball off a bumper, make an aim line from the white ball to the bumper and reflect it on to the opposite side. Make the angles on both sides match and you're in.

improve performance. After that, it declines by 10 per cent with each additional beer. ● The behind-the-back thing never works. ●

SKILLS

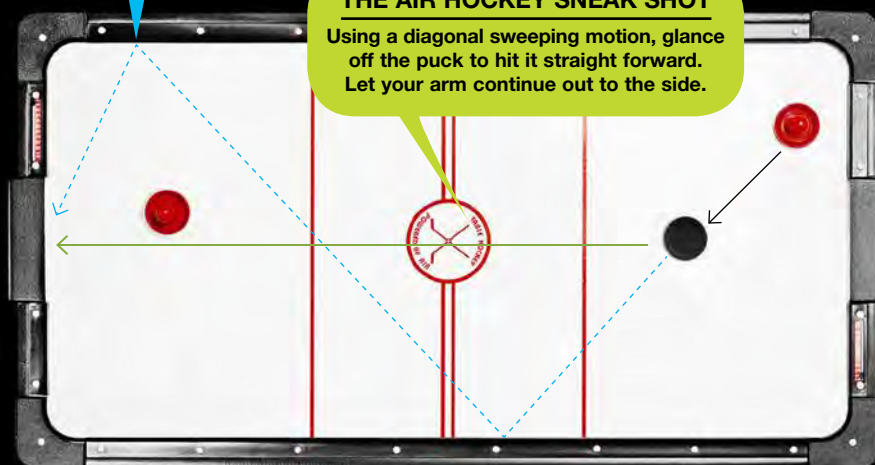
REC ROOM

THE UNEXPECTED BANK

Imagine a horizontal line that extends from your opponent's mallet. Aim a hard bank shot at the side wall behind that line and you're in.

THE AIR HOCKEY SNEAK SHOT

Using a diagonal sweeping motion, glance off the puck to hit it straight forward. Let your arm continue out to the side.



• AIR HOCKEY

SPEED

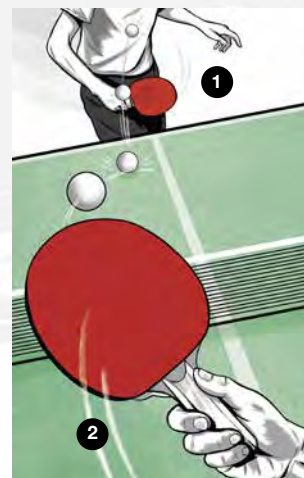
Air hockey is a fast-moving game that, like ice hockey, is as much about velocity and guts as it is about technique. To keep up, you need a loose grip that will allow you to move your wrists: instead of clutching the mallet handle, place your hand over it, with your middle finger in front of the knob and your index and ring fingers behind it. Also: change up your shots

WITH THANKS TO

TABLE-TENNIS: Jim Butler, three-time US men's singles table-tennis champion. **DARTS:** Scott Braese, The American Darters Association No. 1 steel-tip dart thrower of 2014. **AIR HOCKEY:** Mike Prendergast, technical manager, Valley-Dynamo air-hockey-table manufacturers.

occasionally. After a long volley, hit a few slower shots to draw your opponent away from his goal. Then, when he's least expecting it, surprise him with a deep bank shot or a bullet that moves in a different direction to your arm (see diagram, above).

If all else fails, try the distraction technique, shouting out facts about air-hockey tables while firing off slap shots. For example, the puck is made of glass-filled Lexan plastic. It weighs a little less than 43 g. The ridge around the edge is what lets it float on the air coming up from all those little holes. Have you won yet? Tell your opponent his fly is down.



• TABLE TENNIS

SPIN

In table-tennis, as in marketing and politics, winning is all about spin. A ball flying through the air is moving in two ways. There's straight velocity, the motion of the ball directly towards or away from you. And then there's spin, the angular velocity of the ball rotating over itself. The latter is what causes the ball to do spooky, spectacular things, like ricochet off the table, over your opponent, and under a chair in the corner of the room. All table-tennis players try to give topspin, where the ball rotates over itself, bottom over top, as it's moving towards the other player. This will make the ball speed up after it bounces on the table, jarring the opponent and conferring an advantage.

1. In general, a shot fired into the centre of the chest is the most difficult kind to return, so aim for the middle of your opponent's body.

2. To give topspin: using a paddle with a bit of rubber on it, like the Tibhar Volcano X, push up and over the ball, adding a little extra oomph to counter any spin from your opponent.

If you have to ask yourself whether you are too drunk to take a particular shot, the answer is yes. ● Cheating while someone is



THE PARABOLIC ASSUMPTION

A light dart will follow a greater vertical arc, so aim slightly lower than your target so as not to hit too high.

• DARTS

AERODYNAMICS

Darts are like really sharp, slow-moving bullets: they travel on a ballistic parabolic trajectory, arcing up and then down. The harder you throw, the straighter the dart will fly, but you'll have less control. So control your stance. Point the toe of your throwing side towards the board and open your other leg to the side. Limit your movement to the elbow and wrist. Extend your arm about three-quarters of the way and release the dart. Follow through until your finger is pointing at the board. See, it's just like a gun.



To keep a shot straight, find the dart's centre of gravity and balance it on your thumb, letting your fingers gently hold it in place.



If you're just starting out, try the Shot 803 Steel Tip Dart in 28 g weight. It's heavy enough to straighten out a wobbly beginner's throw.



Unless you're playing some weird game, always aim for the triple 20. It's worth 10 points more than the bull's-eye, and it's bigger.

HOW TO WIN AT FOOSBALL AND ALIENATE PEOPLE

In the professional soccer world there exists a style of play known as tiki-taka, in which small, technically skilled players work their way up the field using short, quick passes. You should not try to use tiki-taka to play Foosball. Unless you plan on spending years honing your craft, you will be aggressively bad at it. You will attempt to pass to your midfield 5-bar and it will bounce off and squirt back into your own net as you pump your 3-bar back

and forth. Instead, use your goalie to shoot long shots. No one expects it, and your opponent will not have aligned his defenders, allowing you to catch him off-guard. Also, angle your 3-bar so your guys are all leaning forward. When a pass comes from the back, it will stop under them. This way you can control the ball and hammer shots from close range.

To defend, align your 2-bar so that one guy is covering half the

net. Cover the other half with your goalie. It's simple, but most of the time your opponent won't be able to navigate past it. When you inevitably win, shake your opponent's hand, look him dead in the eye, and tell him, "Tiki-taka is dead." Then walk away and start smoking a vanilla-scented cigarillo while pretending to talk on your cellphone. He won't know what you mean, but he'll know you're dangerous.

— KEVIN ALEXANDER

buying a round will result in immediate reincarnation as a floor in the bathroom. ● For the last time, there is no spinning in Foosball.

SKILLS

TAKING STUFF
APART

HEAT-DISSIPATION SHEET

Located behind the sensor, this copper-foil sheet passively diffuses heat to keep your camera cool.

MAIN BOARD

This circuit board connects the power ports to the battery and the memory card to the sensor. It's also where you'll find the internal memory. If the lens is your camera's eye, this is its brain.

Our
dismantler:
NYU Polytechnic
School of
Engineering
student Wilson
Zhong



THIS WAS A FUJIFILM X30 CAMERA

We took the classic inventor's approach to figuring out how a new compact camera works: we broke it.



FLEXIBLE PRINTED CIRCUIT

These copper ribbons carry information from the sensor to the digital viewfinder (the black cube at left), so you can see what you'll get before you snap.

LENS BARREL AND UNIT

These two pieces arrange 11 individual glass lenses in a line to focus the image you want to capture on to the sensor. Three of the lenses are aspheric (to prevent distortion), and two are made of extra-low-dispersion glass (to enhance sharpness).

X-TRANS CMOS II SENSOR UNIT

"A lens forms an optical image; there's nothing digital," Wang says. "The sensor converts the light signal to an electronic signal." This black square contains millions of tiny transistors, each of which records the light intensity for a single pixel of red, green or blue.

FLASH CAPACITOR

"This thing shocked me twice," Zhong says. "It stores power for the flash."

IF YOU BUY A FUJIFILM X30 CAMERA in a store, the salesperson will tell you about its short-lag electronic viewfinder. He will tell you that it's undergone a redesign since its previous incarnation, the X20. But he will not tell you the fun stuff: that it contains hundreds of prickly, mysterious parts, dozens of which are hellishly tiny screws and one of which is a capacitor that can still shock you even with the battery disconnected. Wilson Zhong, the New York University Polytechnic School of

Engineering student who helped us disassemble the X30, found all this out the hard way. He unscrewed each of these tiny screws by hand. Then, with the help of electrical engineering professor Yao Wang, Zhong was kind enough to explain what some of these parts do, so you can leave your camera in one piece. It works a lot better that way. So, why did we destroy ours? To, um, see what was inside.

SKILLS

TOOL TEST

BEST
OVERALL

THE PREDATOR OF POWER TOOLS

An abrasive chop saw can cut nearly anything.

WHEN YOU'RE SLICING STEEL REBAR, the resounding clang of metal hitting the floor of your garage might as well be a carnival-game winner's bell. Steel is hard. You could use a hacksaw, an angle grinder, or even a torch to cut it, but an abrasive chop saw is a better choice: because it uses an abrasive disc instead of a saw blade, it has no teeth to get stuck and can plough through rebar, cast iron, steel pipe, or chunky angle stock. With one of these saws, you could cut yourself a mailbox post or – you could build an entire hot rod. We gathered five 355 mm chop saws, mounted an industrial-grade Norton Gemini Rapid Cut abrasive wheel on each, and chopped through stacks of steel studs and a pile of 3 mm-wall steel tubing. Sparks flew. Steel fell. And a winner emerged.

A BRIEF LESSON IN SPARK PATTERNS

Assuming you're wearing safety glasses, the sparks that fly off an abrasive chop saw won't hurt you, but they can become a nuisance. Have a friend take a picture while you make a cut. You should see sparks shooting straight out the back or side of the saw. If they are flying everywhere, try tipping the top of the deflector towards you to direct more of the sparks downward.

★★★★★

DEWALT D28715 R5 080

Vice capacity: 24 cm

Tube-cut time: 11,14 sec

Likes: This was the only saw that allowed tool-free blade change, and it has a vertical spring behind the head, which makes it easy to move.

Dislikes: A 2 m power cord is barely long enough to stretch across a workbench, let alone a metal shop.



★★★★★

DEWALT 28700-B1 R2 824

Vice capacity: 13 cm

Tube-cut time: 15 sec

Likes: On-board wheel change wrench allows for convenient storage and greatly reduces the risk of lost wrenches.

Dislikes: The power cord, even at 3 m, is still very short for a working environment.



★★★★★

HITACHI CC14SFS R3 031

Vice capacity: 20 cm

Tube-cut time: 10,0 sec

Likes: The Hitachi was the most comfortable straight-handled saw and the easiest to use. The deflector contains sparks well.

Dislikes: Terrible chain-and-catch-locking mechanism.



★★★★★

Bosch GCO 2000 R3 295

Vice capacity: 22,25 cm

Tube-cut time: 13,0 sec

Likes: It's smooth-running and has a wheel cover that provides unfettered access to the arbor bolt when necessary.

Dislikes: Again with the weird chain-and-catch-locking mechanism.



★★★★

RYOBI C355 R2 050

Vise capacity: 22 cm

Tube-cut time: 12 sec

Likes: This model is widely available and constantly on special somewhere for even cheaper.

Dislikes: Spare parts are very rare for this older model

BEST
VALUE



ASK ROY

POPULAR MECHANICS' senior home editor solves your most pressing problems.

When we moved in, our new house had that cat smell. We cleaned the carpet and everything seemed fine – until we turned on a heater. Now it's back. What can we do?

It's a rude awakening, in the literal sense of that phrase, when a foul pet odour returns once the heating system comes on. If areas of the carpet were saturated, it's likely that the subfloor is thoroughly stained and the odour is coming from the lumber below.

Here's the bad news: the carpet has to come up, and the subfloor needs to be sealed. The good news is that this is a relatively simple job. Once the carpet is up, use an odour-sealing paint, such as

Plascon Wood Primer. This is a linseed-based alkyd-resin primer (translation: you should clean your tools with paint thinner) that you can brush over the subfloor and other affected surfaces, such as skirting boards. While you're at it, seal the baseboard trim and the lower part of the walls, and paint those as well. Then reinstall the carpet. That, and a few scented candles, should take care of it.

The shelves on my bookcase are starting to sag in the middle. Do I have to toss it?

Not necessarily. Obviously, you should start by moving your copies of *War and Peace* and *The Complete Works of William Shakespeare* from the centre of the shelf to the side. This will reduce the shelf's downward bend, but you may need to take a second step to fix the whole problem. You can stiffen shelves made of wood, plywood or particle board in two ways. The first is to glue and screw a long, narrow strip of wood down the centre of the shelf's bottom, like a racing stripe. The second is to glue and nail a short, vertical rectangle of wood to the front edge of the shelf so that it acts like a beam. If the shelf is removable, glue a strip to the back edge as well.

I recently put together a project that called for a power driver, but there were a couple of fasteners I had to screw in by hand. Is there an easier way to do this than switching back and forth between tools?

Power driving is a godsend when you have to add or remove a lot of screws in a hurry, but you need a hand tool when the work calls for a lighter touch, such as tightening a terminal screw on a light switch. Bosch has a nice, neat compromise. Their Clic Change bit system has a spring-loaded locking collar and a set of bits that can be transferred from a drill or impact driver to a bit handle quite quickly. The bits fit into a spring-loaded collar chucked into your drill, and a backward click releases them so you can shift them into a handle. I was impressed with the fit: it's tight, but you can still easily remove the bit.

What's with the gross, sooty glass on my nice woodstove?

I was recently relaxing in front of the woodstove at my youngest brother's house. I asked him how he keeps the glass so clean, and he said he washes the surface twice a week with a specialised cleaner, Megamaster Hot Glass Cleaner, and he burns a hot fire using seasoned hardwood. Besides brightening the glass, the cleaner leaves a protective film that makes the next wash easier. You'll want to apply it with a white Scotch-Brite pad designed to clean ceramic, chrome, and stainless steel. Wipe the residue off with a moist paper towel, followed by a dry one.

There's also the old home-style solution – wiping the glass with a paste made of water and wood ash, then scrubbing with newspaper. Whichever option you choose, don't do anything that will void the stove's warranty.



PHOTOGRAPHS BY BEN GOLDSTEIN

WHAT'S IN ROY'S GARAGE?

Our columnist on his favourite new tool.

I can't stop talking about the new inductive-charging impact driver and wrench from Bosch (model IDH182WC-102). It prevents the worst moment in any project: when you're busy and your tool suddenly powers down. This driver will not do that, because it's the first tool that easily charges while you work. Its charger emits an alternating magnetic field. Set the tool down on it and a copper receiver coil in the battery converts the field into power. It's fast too. The driver recharges from dead to 80 per cent capacity in a half-hour. It costs a pretty penny, but you'll save about that much just on contributions to the swear jar.

THE ONE-HANDED KITCHEN RENOVATION

Smartphone and tablet apps let even the most design-challenged play architect.

BY DAVID OWEN



than the cost of a good drafting pencil. I recently spent R120 for one such app, a 3D planning tool called Interior Design for iPad that came highly recommended. In comparison with that first home CAD package of mine, it's a miracle of sophistication. With it you can use an iPad to create, decorate and furnish three-dimensional models not just of rooms but of multistorey houses – and to enlarge, shrink, tilt and rotate everything as you go along so you can see what your creations look like from different angles and on different scales.

(At one point I worried that I'd erased a roomful of furniture, but then I realised I'd merely supersized the space and wandered under a counter.)

To test the capabilities of these sorts of apps, I decided to see how closely Interior Design for iPad could reproduce our actual kitchen – which we eventually did renovate, at frightening expense, with the help of a professional kitchen designer. During my first hour with the app, I got so angry with it that I was tempted to throw my iPad (in truth, my wife's) into the driveway. The FAQs on app developer Black Mana Studios' Web site were no help: "We are currently we are working on solution, that will allow to work on all platform much easily." (The company's founder is from Israel, and the chief technology officer is from Russia.) But I

calmed down and in the end produced an impressively accurate simulacrum.

Not that everything worked smoothly. Interior Design includes several thousand elements that you can drag into floor plans – doors, chairs, floor tiles, clocks, air conditioners, toilets, dustbins, toys, potted plants. You can move them around; change colours, sizes, and building materials; and even import photographs and blueprints of your own. But some of the elements are exasperating to work with. You can duplicate a custom ottoman, for example, but not a



WAY BACK IN THE 1990S, when my wife and I were first beginning to think seriously about renovating our kitchen, I bought a software package that was billed as a home version of the computer-aided design programs that architects had begun to use in preference to pencil and paper. I spent a couple of days wrestling with it, but in the end the "plans" I produced were so dumb-looking that I couldn't bring myself to show them to my wife.

Consumer computer programs have come so far since then that we don't even call the majority of them programs anymore. There are Photoshop-calibre consumer CAD programs for desktops, sure, but there are also more than 1 500 architecture apps in the iOS App Store, and almost all of them can be downloaded instantly for less

From top: Interior Design for iPad's walk-through capability; a sample floor plan; populating the app with furniture and materials.

custom window, which means that, if you want to use a dozen identical windows that don't happen to be exactly like any of the (not entirely standard) ones that come with the app, you have to manually enter the dimensions and positioning details for each one. And although the app will tell you, say, how far the edge of a table is from a wall,

At one point I worried that I'd erased a roomful of furniture, but then I realised I'd merely wandered under a counter.

it won't tell you how far it is from the counter that is attached to the wall – useful information if you're trying to decide what will fit and what won't.

In short, for a little over R100 you're not getting your own personal interior designer. What you're getting is more like a Roomba with a sketch pad that speaks poor English, but can put together a respectable map of your home. In an industry where you can buy a couch for what it costs to hire a professional to recommend that you place it across from the TV, that's a heck of a deal.

Not an iPad user, or just want to try something different? Here are two great, free home-design apps that are available for both Android and iOS.



MagicPlan

This app's strongest recommendation is its ease: you can create a floor plan and measure the dimensions of a room by taking a picture, then use the app to adjust and rotate furniture.

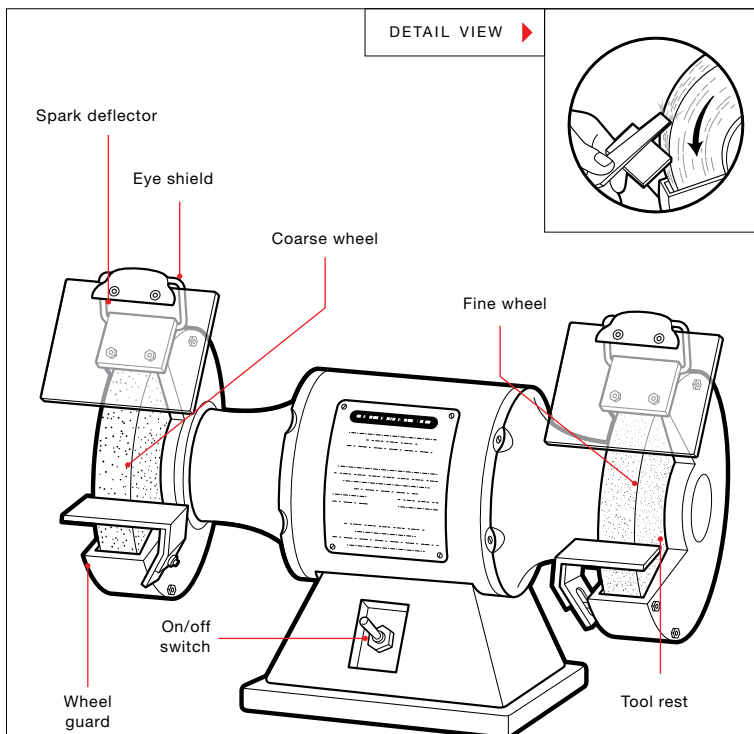


Autodesk Homestyler

Tailored for the US market, populate plans of your place with models of fixtures and furniture from companies like Crate & Barrel, Ethan Allen, Restoration Hardware, and Kohler. Then link through to buy your piece.

SKILL OF THE MONTH

How to use a bench grinder



The bench grinder is the undergraduate philosophy major of the workshop: a machine that's obvious, abrasive and designed to grind every item it encounters to an attenuated shell of its former self.

Depending on which wheel you add, a bench grinder can shape, sharpen, buff, polish or clean just about any metal object. To use one, attach the coarsest wheel that works for your job: 36-grit can sharpen most gardening tools; 60-grit is better for chisels and plane irons. Eighty- or 100-grit wheels are best reserved for delicate jobs, such as shaping metal model parts and inefficiently peeling potatoes.

Next, place the item you wish to grind against the front wheel at roughly a 25- to 30-degree angle (see diagram, above). Keep it moving. The combination of rough grit and constant motion will keep the metal from overheating. Well, mostly. If your drill bit or tool starts to heat up, dip it in a coffee can full of warmed fast-quench oil such as Brownells Tough-Quench or Chevron Quenching Oil 70. This will prevent the microscopic cracks that can develop from cooling a hot tool too quickly by splashing it with cold water, which, incidentally, is still the preferred treatment for philosophy majors.

SKILLS

WORKSHOP
CHALLENGE



@ EASE

Our inaugural Home Workshop Challenge was fiendishly simple: create something using a single sheet of plywood as your only source of timber.

TO BE HONEST, WE EXPECTED VARIATIONS ON A BOX.

But *POPULAR MECHANICS* folk rise to the challenge, it seems. So what we got was a ukulele stand, a braai, a magazine rack and children's furniture. In the end, though, the judges came down in favour of a project that they felt epitomised the PM ethos of hands-on involvement. It's a feel-good story, too. The winner: Etienne and Kennard Ward's lounge. Here's how they did it, in the words of Etienne.



MEETING THE CHALLENGE

My son, Kennard, 11, often absconds with *POPULAR MECHANICS* as soon as it arrives in the post, so he was first to spot the plywood umbrella and the competition.

The key thing to understand is that we are not a father-and-son woodworking team. Our skills are limited and tools are few, but the challenge, oh the challenge – there is always a gift in any challenge.

And so we set about deciding what we would construct. We spent days together staring at the sky, imaging the great works of art our hands would sculpt out of one piece of plywood. There was a boat, a Christmas tree, a sweet dispenser, a go-kart – obviously we were dreaming far beyond our abilities, dangerously far. People could get hurt.

We finally settled on a lounge. This seemed to be within our abilities, we confidently surmised. My daughter Kathleen was roped in as official photographer and

my wife allowed me to use her SUV to collect the 9 mm plywood board. We chose 9 mm, not because of any design element, but because we thought it stood a better chance than the 6 mm board of surviving the trip home.

Once back home, we stared at the huge board lying on the garage floor with a nagging doubt that we might be in over our heads. My son came to the rescue here with some practical advice – if you want to build a lounge, BE the lounge. It encouraged us no end and was very uplifting. After 10 minutes of big-talk and high-fives we stood staring at the board again.

The rules said we had to document the build, so we took a few photographs. Of the board on its own, of ourselves with the board, of the cat on the board... and then we stared at the board again.

Eventually, we grabbed a pencil and paper and started outlining what we thought would be a great lounge. We then transferred this plan to the plywood – with careful measurements and much debate. Ken had a few great ideas, such as putting the wheels on the inside, to try to keep the sleek look, and cutting a semi-circular hole on the "foot" end of the lounge so it could be picked up and trolleyed about (I was going to use a handle). The storage place underneath was another good idea – big enough for a few towels and slip-ons.

Now jigsaw control was a challenge, but after a broken blade

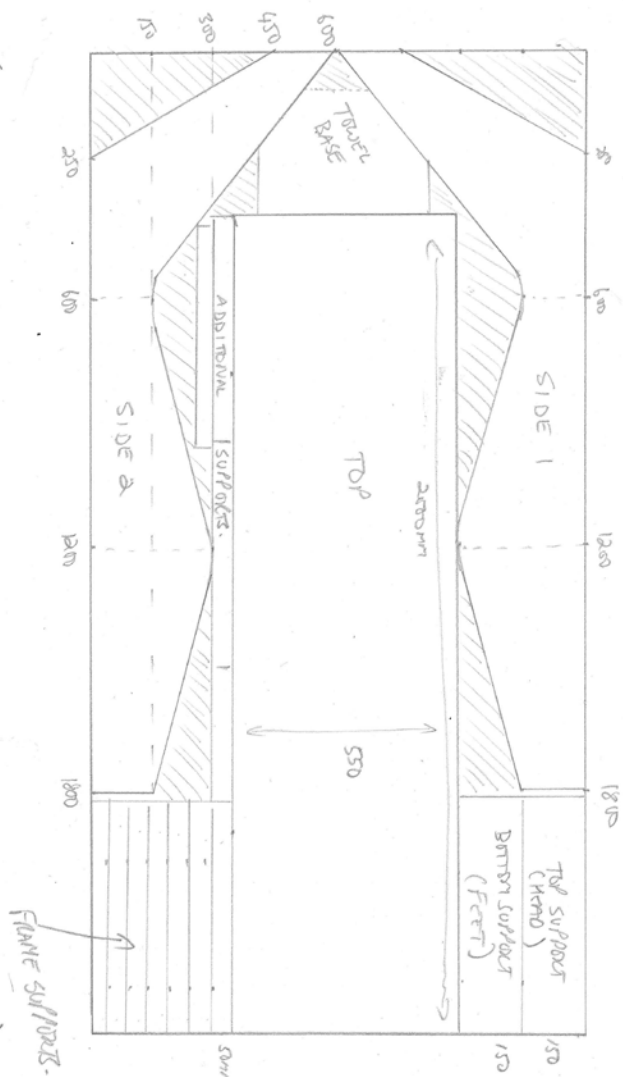


and a few near-misses we soon got the hang of it. After cutting out all the pieces it became like a jigsaw puzzle of putting pieces together.

Building the frame was straightforward; we used lots of glue and 6 x 25 mm brass screws for all our joints. Once the frame had been built, we had to bend the 9 mm plywood top base (the seating area) on to the frame. This was a key learning area – 9 mm plywood does not bend easily. It took four days of torturing the poor sheet of plywood on to the frame. We soaked the sheet in water and strapped it on the frame with heavy bricks and ratchet sets, slowly tightening the tension every day.

On day five, the plywood sheet was holding the shape of the frame – sort of. So we glued and screwed it to the base. Minor evils and unintended slips were covered and filled with wood filler and then Ken painted our masterpiece with four coats of acrylic enamel, performing a light sanding between the first two coats.

So what was the gift of this challenge? As far as I am concerned, I have already won the prize. I was able to spend quality time with my son (and stare down the paparazzi in Kathleen) and the 33-year difference in our ages did not matter – we were equals. There was no talk of selfies, Instagram, Facebook, Twitter or computer games – it was all about the challenge.



AND ANNOUNCING: WORKSHOP CHALLENGE NO 2

Accept the PM Home Workshop Challenge and a top-of-the-range cordless drill driver kit, valued at R6 794, could be yours.

CONTEST NO. 2

THE CHALLENGE: devise a joint project for a father and son. Or a mother and daughter. Guardian and ward, for that matter. We want to see something that can transcend the generation gap, perhaps even put that gap to good use. To get an idea of what we're after, see our "Walking stick robot" project on page 96.

PRIZE:



The winner will receive a **Makita DHP458ZK Cordless 18V Lithium-Ion Impact Driver Drill Kit**, valued at **R6 794**. This top-of-the-range Makita 13 mm impact driver drill features a battery indicator that displays the remaining battery charge; twin LED lights that illuminate when the trigger is pressed and 3 functions – drilling, hammer action and screw driving. The DHP458ZK provides plenty of power for those demanding tasks, with 21 torque settings to choose from, giving you perfect control and maximum torque of up to 91 N.m. It is extremely compact, with a two speed metal gearbox and steel keyless chuck. It features a rubberised grip, an extended side handle for greater control, a reversible belt clip for both left- and right-handed operation and a twin bit holder.

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For further information, visit www.makita.co.za, like Makita on Facebook **Makita-PowerToolsSA** or call 011 878 2600.

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Email your plans and a picture of the results to popularmechanics@ramsaymedia.co.za by 17 April, 2015.

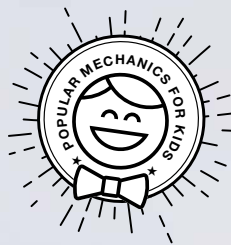
Official rules can be found at popularmechanics.co.za

Makita Popular Mechanics

A project to build with your children

BY JENNY YOUNG, owner, Brooklyn Robot Foundry

WALKING STICK ROBOT



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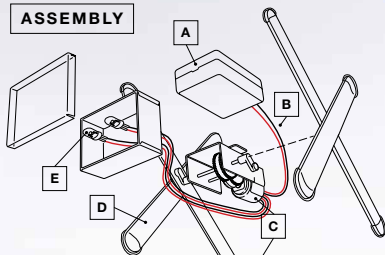


TIME: 2 hours (or less)

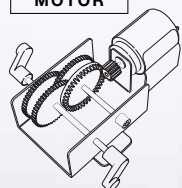
AGES: 7+

T **THIS LITTLE** machine is loaded with lessons about engineering and mobility. The gearbox teaches kids how gear ratios affect speed. And when it walks, the robot's feet can slip unless you add a dab of glue to them. That's a great introduction to problem-solving: increasing friction to create traction and enable faster movement. The pipe cleaners are just pipe cleaners. Have fun!

ASSEMBLY



GEARBOX AND MOTOR



Plastic battery package becomes the robot's head!



MATERIALS AND TOOLS

(all available at hardware and craft stores, except where noted)

PART	QTY.	DESCRIPTION
A	1	Two-battery AA or AAA case, with switch
B	2	125 mm pc. each red and black electrical wire
C	1	Elenco 2-in-1 or similar Gearbox Strength: 1:288; speed: 1:60 (elenco.com)
D	4	Ice-lolly stick
E	2	3-volt, 10-mm LED (leading-leds.com)
		Lightweight plastic box, open back (we used the batteries' packaging)
		- wire cutter/stripper - duct tape - scissors - hot-glue gun - electrical tape - glue sticks - craft supplies

INSTRUCTIONS

● parent only ● parent and kid ● kid only

STEP-BY-STEP

1. Assemble gearbox using the manufacturer's instructions.
2. Strip 10 mm of insulation from the end of each wire.
3. Twist a red wire on to the long leg of one LED, and a black wire on to the short leg. Repeat with second LED.
4. Attach the battery case's red and black wires to the motor terminals. The red wire goes to the terminal near the + sign.
5. Twist the red LED wires around the red wire attached to the motor, and cover the connection point with electrical tape. Repeat with black wires.
6. To add rigidity to the wires connecting the LEDs to the motor, wrap each pair of wires tightly with electrical tape.
7. Hot-glue the battery case on to the back of the gearbox.
8. Hot-glue the ice-lolly sticks into two Xs, and then glue one X to each end of the gearbox axle (we reinforced the connections with red duct tape).
9. Hot-glue both LED wires to the curved underbelly of the motor mount. Hot-glue the LED bulbs to the inner sides of the plastic box.
10. Decorate with craft supplies to make the robot look awesome.

PHOTOGRAPH BY BEN GOLDSTEIN

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Competition rules: 1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia and associated agencies.

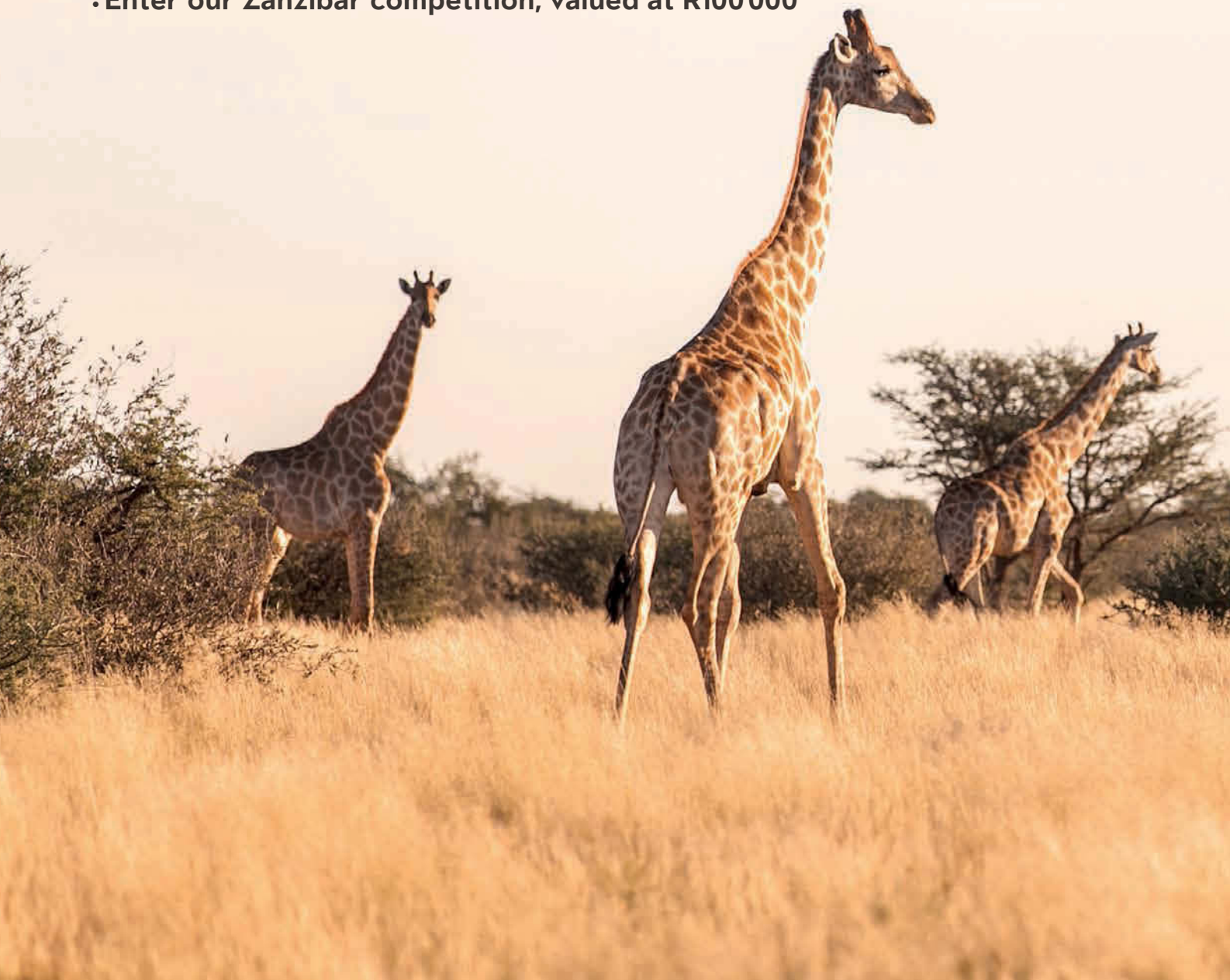
2. Only one online entry per person. You may enter via SMS as many times as you like (R1,50 per SMS; this service does not allow for 8ta numbers).

3. Competition runs until 31 March 2015. 4. We will draw the winner(s) on 8 April 2015. 5. The prize is not redeemable for cash. 6. Prizes not claimed within 3 months will be forfeited. 7. The judges' decision is final and no correspondence will be entered into. 8. Regrettably, only South African residents are eligible for prizes. 9. By entering this competition, you agree to receive future correspondence from Popular Mechanics. You can opt out at any stage by: (a) Sending an email containing the relevant details with the subject line "opt out" to pmmailers@ramsaymedia.co.za; or (b) Sending an SMS including the word "STOP" to 31699. Standard SMS rates apply.



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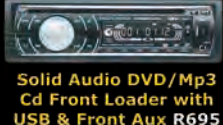
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Cut off the excess paper and use it to make a stopper to keep the casing from sliding too far into the paper (as shown in picture 1). Next, put the casing in the paper holder and start packing the balls into the slit between the casing and the paper. If you are finished, it should look something like picture 2.

Last, if the balls are packed tightly enough you should be able to pick it up, turn it upside down and drop it into the female part of the casing without too much hassle

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Handy empties

By fitting empty containers (as shown above) on your ladder, you won't have to run up and down the ladder if you work above your head with a drill. This can also be used when welding, to store your clamp. If a screw top is fitted, you can also keep your welding rods close by.

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Dead centre

Drilling through a pipe or dowel can be a pain as the tip of the bit skitters off-centre. This guide prevents that.

Drill three holes in a length of wood, (here 32 x 32 mm): the centre hole for the hole or pilot hole in the dowel or pipe being dead centre, the outer two being precisely positioned from the ends. Add two lengths of the same wood and attach with screws, firmly, but so that the end pieces can swivel. The inner surfaces of the end pieces must be exactly the same distance from the centre hole.

Hold the pipe or dowel in the guide as shown, and drill through the centre hole. This guide also works well for larger diameter pipes, when it sits on top of the

High hoe

I extended a hoe handle to shoulder height by slipping a 35 mm diameter aluminium pipe over the longer handle. I attached a drill handle. Result? You can use the tool with no strain on your back.

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